

Understanding and improving vocal health: A tiered investigation into a group of Occupational Voice Users

by

**Rouxjeanne Vermeulen
(13206258)**

A thesis submitted in fulfilment of the degree

Ph.D. (Speech-Language Pathology)

**In the Department of Speech-Language Pathology and Audiology
Faculty of Humanities University of Pretoria**

SUPERVISOR:

Professor Jeannie van der Linde

CO-SUPERVISOR:

Doctor Maria du Toit

6 June 2023

The language used in the thesis is English (U.K.). Stylistic and language variations required by the specific journals where the manuscripts of the studies were submitted are indicated where applicable.

No part of this work may be reproduced in any form or means, electronically, mechanically, by print, or otherwise without prior permission by the author.

Rouxjeanne Vermeulen
Department of Speech-Language Pathology and Audiology
University of Pretoria
Pretoria
South Africa
rouxjeanne.vermeulen@up.ac.za

*“How wonderful is the human voice! It is indeed the organ of the soul.
The intellect of man is enthroned visibly on his forehead and in his eye,
and the heart of man is written on his countenance, but the soul, the soul
reveals itself in the voice only.”*

Henry Wadsworth Longfellow

ACKNOWLEDGEMENTS

"Walk with Me and work with Me - watch how I do it. Learn the unforced rhythms of grace. I won't lay anything heavy or ill-fitting on you" (Hebrews 11:29)

First and foremost, I would like to honour God who gave me the strength and resolve to complete this task. In the two and a half years that I have written this dissertation, there have been deep valleys to cross, but also glorious mountains I have stood upon. Whether I was in the valley or on the mountain, the Lord has never failed me. He is ever faithful to his word and promises. Through a journey of diligence and endurance, He has taught me the unforced rhythms of Grace. Then there are a few people I'd like to thank. To my supervisors, Prof Jeannie Van Der Linde and Dr. Maria du Toit. I am deeply grateful for the countless hours you have both invested not only in this document but also in me. Thank you for your unending guidance, encouragement, and expertise over the last two years. Thank you for becoming so much more than just my supervisors, but also my friends. To my statistician, Prof Marien Graham, you have genuinely been my helping hand and I am ever grateful for your exceptional skill and expertise. Prof Kristiane Van Lierde, I am so thankful for your international perspective and the guidance I received from you over these past years. This team held my hands high when I grew tired. From my Masters to my Ph.D. Thank you for running this race with me. To my loved ones, without your prayers, financial sacrifices, and emotional support, I would not have been where I am or who I am today. I would like to sincerely honour the following people; My Husband, André; you have been my constant support and motivator in this process. Your love and care have enabled me to pour my time and energy into my research while you cheered me. I will never be able to express how thankful I am for all the sacrifices you have made for me to be able to reach my dreams, I love you endlessly. My son Auden, from being pregnant to becoming a mother to watching you grow has been one of my biggest challenges but also my biggest privilege while busy with this Ph.D. process. You inspire me to be better and achieve more daily. You are my greatest gift and I love you so. My mother Sonja, you have been my first and most loyal fan from day one. I honour you for how gracefully

you have faced this life and these last few years. You are the glue that binds us as a family. Your silent strength is remarkable and I will always be in awe of you. Thank you for your never ceasing prayers for me throughout my postgraduate studies. My brothers, Ruwan & Hanru, you have both inspired me with your perseverance and work ethic in your own lives. The Vermeulen family, Andre Snr, Nadine, Tiaan, Roné, Kyla, Ryno, and Lynelle, me and Andre will always be thankful for the love and immense support you showed us through this challenging time, I love you all with my whole heart. The Swanepoel family, your care for me, and wise counsel has been instrumental through my Ph.D. years, thank you for being a second family to me. To our Life-group, our weekly meetings, and all the prayers meant so much in carrying me through this last stretch. Tannie Rina, your prayers and care for me over the years have also never ceased. To everyone who has really been a friend, an ear or shoulder through every step, thank you for the endless support you have shown me: Rochelle & Trevor and all my friends who have become family. I love and appreciate you all dearly. I am forever grateful to each and every one of you and the roles you have played in my life.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	4
TABLE OF CONTENTS	6
LIST OF TABLES	7
LIST OF FIGURES	8
PUBLICATIONS AND RESEARCH OUTPUT	9
PLAGIARISM DECLARATION	11
ETHICS STATEMENT	12
ABSTRACT	13
KEYWORDS	17
ABBREVIATIONS	18
DEFINITIONS OF KEY TERMINOLOGY	20
CHAPTER 1	23
INTRODUCTION	23
CHAPTER 2	29
METHOD	29
CHAPTER 3	48
THE EFFECT OF VOCAL HYGIENE EDUCATION PROGRAMS ON VOICE QUALITY IN PROFESSIONAL VOICE USERS: A SYSTEMATIC REVIEW	48
CHAPTER 4	14
SELF-REPORTED VOCAL DEMANDS, PERCEPTIONS AND KNOWLEDGE OF OCCUPATIONAL VOICE USERS IN SOUTH AFRICA	14
LEARNING OUTCOMES	34
CHAPTER 5	35
THE OUTCOMES OF THE VOICE USE REDUCTION PROGRAMME ON VOCAL QUALITY AND VOCAL FATIGUE IN OCCUPATIONAL VOICE USERS	35
LEARNING OUTCOMES	2
CHAPTER 6	3
DISCUSSION, CLINICAL IMPLICATIONS AND CONCLUSION	3
REFERENCES	12
APPENDICES	13

LIST OF TABLES

Table 2.1. Summary of research studies.....	30
Table 2.2: GRBASI 4-point Rating Scale (Yamauchi et al., 2010).....	38
Table 2.3: Acoustic Voice Parameters.....	38
Table 1.1: Newcastle-Ottawa Scale (NOS) for assessing the risk of bias (Higgins et al., 2011)	55
Table 1.2: Study characteristics and main findings.....	1
Table 1.1. Participant medical characteristics (n=100).....	21
Table 1.2. Participant's voice use characteristics (n=100)	22
Table 1.3. Participant habits in terms of daily intake (n=100).....	22
Table 1.4. Spearman correlations between variables and Factors in the VFI (n=100)	24
Table 1.5. Spearman correlations between variables and the VHI-10 (n=100).....	25
Table 1.6. Spearman correlations between high voice use and participant vocal symptoms, habits and medical characteristics (n=100)	26
Table 1.1. Participant medical, voice-use, emotional and intake characteristics (n=30)	43
Table 1.2 Frequency Distribution of GRBASI scores (n=30)	45
Table 1.3. Acoustic Parameter Outcomes and Pre-test -Post-test Comparisons (n=30).....	46
Table 1.4. Outcomes and Comparisons for Individual Factors on the VFI (n=30)	46

LIST OF FIGURES

Figure 1.1 Pyramid of voice users, classified according to amount and demand of voice use (adapted from Koufman & Isaacson, 1991)	21
Figure 2.1 The process of manuscript identification.	32
Figure 6.1-Tiered approach to research project and relation to ICF Framework as rationale for the research project.....	6

PUBLICATIONS AND RESEARCH OUTPUT

The thesis is based on the following original articles:

- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (2022). The effect of vocal hygiene education programs on voice quality in professional voice users: a systematic review. *Journal of Speech, Language and Hearing Research*, 65 (12), 4700-4713. https://doi.org/10.1044/2022_JSLHR-22-00097.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (*IN PRESS*). Self-reported vocal demands, perceptions and knowledge of occupational voice users in South Africa. *Journal of Voice*, <https://doi.org/10.1016/j.jvoice.2023.01.032>.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (Submitted o Journal). The outcomes of the Voice Use Reduction programme on vocal quality and vocal fatigue in occupational voice users. Submitted to *Folia Phoniatica et Logopaedica*.

Part of this thesis has been presented at the following local seminars and scientific conferences:

- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (2022). The effect of vocal hygiene education programs on voice quality in professional voice users: a systematic review. *Journal of Speech, Language and Hearing Research*, 65 (12), 4700-4713. https://doi.org/10.1044/2022_JSLHR-22-00097. Poster presented at the South African Speech-Language-Hearing Association (SASLHA) Virtual Conference 2021.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (2022). The effect of vocal hygiene education programs on voice quality in professional voice users: a systematic review. *Journal of Speech, Language and Hearing Research*, 65 (12), 4700-4713. https://doi.org/10.1044/2022_JSLHR-22-00097. Poster submitted to be presented at the 59th South African ENT / AAO-HNS / SAAA / SASLHA conference at the Century City Conference Centre in Cape Town on 20-22 October 2023.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (*IN PRESS*). Self-reported vocal demands, perceptions and knowledge of occupational voice users in South Africa. *Journal of Voice*, <https://doi.org/10.1016/j.jvoice.2023.01.032>.

Poster submitted to be presented at the 59th South African ENT / AAO-HNS / SAAA / SASLHA conference at the Century City Conference Centre in Cape Town on 20-22 October 2023.

- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J. The outcomes of the Voice Use Reduction programme on vocal quality and vocal fatigue in occupational voice users. Submitted to *Folia Phoniatica et Logopaedica*. Submitted to be presented at the 59th South African ENT / AAO-HNS / SAAA / SASLHA conference at the Century City Conference Centre in Cape Town on 20-22 October 2023.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (2022). The effect of vocal hygiene education programs on voice quality in professional voice users: a systematic review. *Journal of Speech, Language and Hearing Research*, 65 (12), 4700-4713. https://doi.org/10.1044/2022_JSLHR-22-00097. Poster submitted to be presented at the virtual RCSLT Conference 2023: Embracing the future together on 01-02 November 2023.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J (*IN PRESS*). Self-reported vocal demands, perceptions and knowledge of occupational voice users in South Africa. *Journal of Voice*, <https://doi.org/10.1016/j.jvoice.2023.01.032>. Poster submitted to be presented at the virtual RCSLT Conference 2023: Embracing the future together on 01-02 November 2023.
- Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde, J. The outcomes of the Voice Use Reduction programme on vocal quality and vocal fatigue in occupational voice users. Submitted to *Folia Phoniatica et Logopaedica*. Submitted to be presented at the virtual RCSLT Conference 2023: Embracing the future together on 01-02 November 2023.

PLAGIARISM DECLARATION

DECLARATION

Full name: Rouxjeanne Vermeulen

Student Number: 13206258

Degree/Qualification: PhD (Speech-Language Pathology)

Understanding and Improving Vocal Health: A tiered investigation into a group of Occupational Voice Users

I declare that this thesis is my own original work. Where secondary material is used it has been carefully acknowledged and referenced in accordance with university requirements.

I understand what plagiarism is and am aware of university policy and its implications in this regard.



Signature

06 June 2023

Date

ETHICS STATEMENT

The author, whose name appears on the title page of this thesis, has obtained, for the research described in this work, the applicable research ethics approval.

The author declares that she has observed the ethical standards required in terms of the University of Pretoria's Code of Ethics for researchers and the Policy guidelines for responsible research.

ABSTRACT

Background: Currently, more than one-third of the global workforce requires integrity of the voice to meet their occupational demands and are therefore considered professional voice users (PVUs)/ occupational voice users (OVUs) (Pomaville et al., 2019; Reed & Sims, 2017). Despite expected vocal load and demand, voice quality, and vocal sophistication differing between professions, all OVUs depend on vocal endurance (Rangarathnam et al., 2018). OVUs' livelihoods depend partially or completely on their voice, yet the prevalence of voice disorders in OVUs is rising due to increased daily vocal demands. In an effort to prevent voice disorders in OVUs, the implementation of Vocal Hygiene Education (VHE) programmes is endorsed (Achey et al., 2016; Pomaville et al., 2019; Porcaro et al., 2019; Rangarathnam et al., 2018). The main goals of VHE programmes are to educate individuals regarding practices to ensure vocal health, balancing muscles for optimal vocal production, and keeping the tissue free of lesions and pathology, particularly for OVUs (Faham et al., 2016; Pomaville et al., 2019). Thus, VHE is a therapeutic and preventive approach based on behaviour modification thought to preserve and protect the vocal fold tissue and normal vibratory characteristics of the vocal folds (Faham et al., 2016; Pomaville et al., 2019). Consequently, VHE programmes require vocal modifications in daily routines to directly improve vocal health, including education regarding voice production, identification and elimination of phonotraumatic behaviours, the importance of adequate hydration and healthy strategies for voice production (Achey et al., 2016; Pomaville et al., 2019; Porcaro et al., 2019; Rangarathnam et al., 2018). Voice use reduction is central to Vocal Hygiene (VH) programmes (Van Der Merwe, 2004) and can be used as a method to modify daily routines aimed at directly enhancing vocal health. Yet, literature reviews show the absence of a standard protocol for voice rest or reduction (Kaneko et al., 2017). The importance and rationale behind novel approaches to the prevention and treatment of voice disorders in OVUs is well established and supported by the International Classification of Functioning, Disability and Health (ICF) framework (WHO, 2001), as occupational participation is threatened and through this, quality of life of the OVU.

Study Aim: To understand and improve vocal health through a tiered investigation of vocal hygiene education, vocal demands, perceptions, knowledge, and voice use reduction in occupational voice users.

This study had the following three research objectives:

- To systematically review the existing evidence on the effect of VHE on the voice quality of PVUs according to the PRISMA-P (Moher et al., 2015) guidelines.
- To describe daily vocal demands, perceptions, and knowledge as reported by OVUs in South Africa.
- To determine the effect of the Voice Use Reduction (VUR) programme (Van Der Merwe, 2004) on voice quality and vocal fatigue in OVUs.

Method: A tiered approach was employed to achieve the main aim of the study and the study objectives. In study one, a systematic review was conducted utilising the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA-P) guidelines. Five databases were searched using the keywords “vocal hygiene”, “vocal hygiene education”, “vocal health”, “vocal quality”, and “voice quality” with Boolean phrases “AND” and “OR”. Twenty-three studies that met the eligibility criteria were included. Scoring was based on the American Speech-Language-Hearing Association’s levels of evidence and quality indicators, as well as the Newcastle Ottawa Scale (NOS) for assessing the risk of bias. In study two, a descriptive, cross-sectional research design was employed by means of a survey on vocal demands, perceptions, and knowledge in OVUs. A total of 100 both male and female OVUs (call centre agents, teachers, lecturers, singing students, and performing arts students) were invited to complete the vocal demands survey using a snowball sampling technique. For study three, a within-subject, quasi-experimental, pre-test post-test research design was performed on 30 OVUs who were randomly sampled from the initial 102 OVUs in study two. Perceptual and acoustic outcome measures were employed pre- and post-implementation of the VUR, including the GRBASI 4-point rating scale, jitter, shimmer, HNR, MPT, frequency min and max, intensity min and max, and the dysphonia severity index (DSI) and perceived vocal fatigue (VF) using the Vocal Fatigue Index (VFI).

Results and discussion: The systematic review revealed three main themes: low awareness of vocal hygiene or insufficient vocal hygiene education is linked to self-reported acute and chronic voice symptoms as well as a greater perception of voice handicap amongst professional voice users ($n=4$; 17%). When voice training or vocal hygiene education was adequate this led to positive voice outcomes ($n=10$; 43%). Vocal hygiene education is more effective when combined with direct voice therapy ($n=6$; 6,26%). Study two discovered that slightly more than half of the participants ($n=55$; 55%) reported using their voice for work 36,5 hours a week on average ($SD= 15,5$, range: 33-40). Participants reported that, on average, their daily voice use is 6,3 hours ($SD= 2,7$) for work and the majority ($n=81$; 81%) reported a decrease in voice quality after work. Three-quarters ($n=75$; 75%) also reported vocal fatigue at the end of the day. Approximately one-third ($n=33$; 33%) reported being exposed to environments where they are expected to shout, scream or cheer loudly. More than half of the participants ($n=61$; 61%) reported that they have previously received vocal health education but ($n=40$) 40% reported that they felt this training was insufficient. High vocal demands are significantly correlated to an increase in perceived vocal handicap $rs=0,242$ ($p=0,018$), tiredness of voice $rs=0,270$ ($p=0,008$), physical discomfort $rs=0,217$ ($p=0,038$) as well as how occupational voice users experience improvement of symptoms with rest $rs= -0,356$ ($p<0,001$). Other risk factors highlighted by occupational voice users are the ingestion of liquid caffeine, alcohol, and carbonated drinks, smoking or the presence of chronic cough, chronic laryngitis and gastroesophageal reflux disease. In study three it was found that pre- and post-test outcomes show significant ($p < 0.001$) decreases in G (Grade of hoarseness), R (Roughness), A (Asthenia), S (Strain), and I (Instability) in post-test. Perceptual normality in all of these areas increased significantly ($p < 0.001$). Acoustic measures revealed significant ($p < 0.05$) decreases in *Jitter%*, Intensity (dB) Min and DSI scores as well as significant ($p < 0.05$) increases in MPT /a/, /s/ and /z/, Frequency (Hz) Max, and *F* (Hz) Max, indicating improved voice quality at post-test. The VUR programme positively affected and improved OVUs' perception of VF in the areas of tiredness of voice and physical discomfort.

Conclusion: The most significant contribution of the project may be that it provides the first known comprehensive description of the outcomes of the VUR Programme on voice quality and vocal fatigue. A novel description of the voice profile of OVUs

requiring voice rehabilitation is introduced. The study adds to the knowledge base of all speech-language therapists, not only in South Africa and those from LMICs, as literature has shown voice profiles and symptoms of OVUs to be similar regardless of demographic area or income status. When approaching OVUs, clinicians are encouraged to make use of a combination of direct voice therapy and vocal hygiene accompanied by the use of sustainable programmes, such as the VUR to help develop healthier use of the voice, foster patient autonomy, facilitate healing and prevent further/future injury. Voice rest has been proposed to decondition the voice whereas voice therapy is thought to recondition the voice (Haben, 2012) and, should therefore be used congruently. These findings serve to promote vocal health consciousness and awareness for preventive voice care initiatives in this unique population, through the use of VHE and the VUR programme.

KEYWORDS

PRISMA-P

Professional voice users (PVU)

Systematic review

Vocal hygiene education (VHE)

Occupational Voice Users (OVU)

Vocal Demands

Vocal Perceptions and Knowledge

Voice Use Reduction (VUR) Programme

Vocal Quality

Vocal Fatigue.

ABBREVIATIONS

ASHA	American Speech and Hearing Association
CCA	Call Centre Agent
COVID-19	Coronavirus Disease of 2019
CSL	Computerized Speech Laboratory
dB	Decibel
DSI	Dysphonia Severity Index
ENT	Ear-, Nose- and, Throat Specialist (otorhinolaryngologist)
F_0	Fundamental Frequency
GERD	Gastroesophageal Reflux Disease
GRBASI	Grade (of hoarseness), Roughness, Breathiness, Asthenia, Strain and Instability
HoD	Head of Department
HNR	Harmonics -to-Noise Ratio
Hz	Hertz
ICF	International Classification of Functioning, Disability and Health
<i>IQR</i>	Interquartile Range
IRB	Institutional Review Board
<i>M</i>	Mean
<i>Mdn</i>	Median
MDVP	Multi-Dimensional Voice Programme
MPEG	International standard for encoding and compressing video images
MPT	Maximum Phonation Time
MS	Microsoft
NOS	The Newcastle-Ottawa Scale
OVU	Occupational Voice User
PRISMA-P	Preferred Reporting Items for Systematic Review and Meta-Analyses
PVU	Professional Voice User
<i>rs</i>	Spearman's correlation

SD	Standard Deviation
SLT	Speech-Language Therapist
SPSS	Statistical Package Social Sciences
SPL	Sound Pressure Level
TV	Television
UP	University of Pretoria
VF	Vocal Fatigue
VFI	Vocal Fatigue Index
VH	Vocal Hygiene
VHE	Vocal Health Education
VHI	Voice Handicap Index
VRP	Voice Range Profile
VUR	Voice Use Reduction
vF0	Fundamental Frequency Variation
WHO	World Health Organisation

DEFINITIONS OF KEY TERMINOLOGY

Occupational Voice Users (OVUs)

In modern society, there are numerous professions who are considered to be OVUs (Devadas et al., 2016). Originally Koufman and Isaacson (1991) described a classification of vocal professionals based on their voice use and risk:

Level I (elite vocal performers): Includes sophisticated voice users like singers and actors, where a slight vocal difficulty causes serious consequences to their identity and careers.

Level II (professional voice users): For whom moderate vocal difficulty would hamper adequate job performance. This includes clergymen, lecturers, politicians, public speakers, and telephone operators.

Level III (non-vocal professionals): Including other teachers and lawyers. They can perform their jobs with slight or moderate voice problems; only severe dysphonia endangers adequate job performance.

Level IV (non-vocal/non-professionals): Include laborers and clerks. These individuals would not be impeded from doing their work when they experience any kind of dysphonia.

Additionally, OVUs are defined by the amount of vocal load and vocal demand placed upon them due to their occupation (Boltežar & Šereg Bahar, 2014).

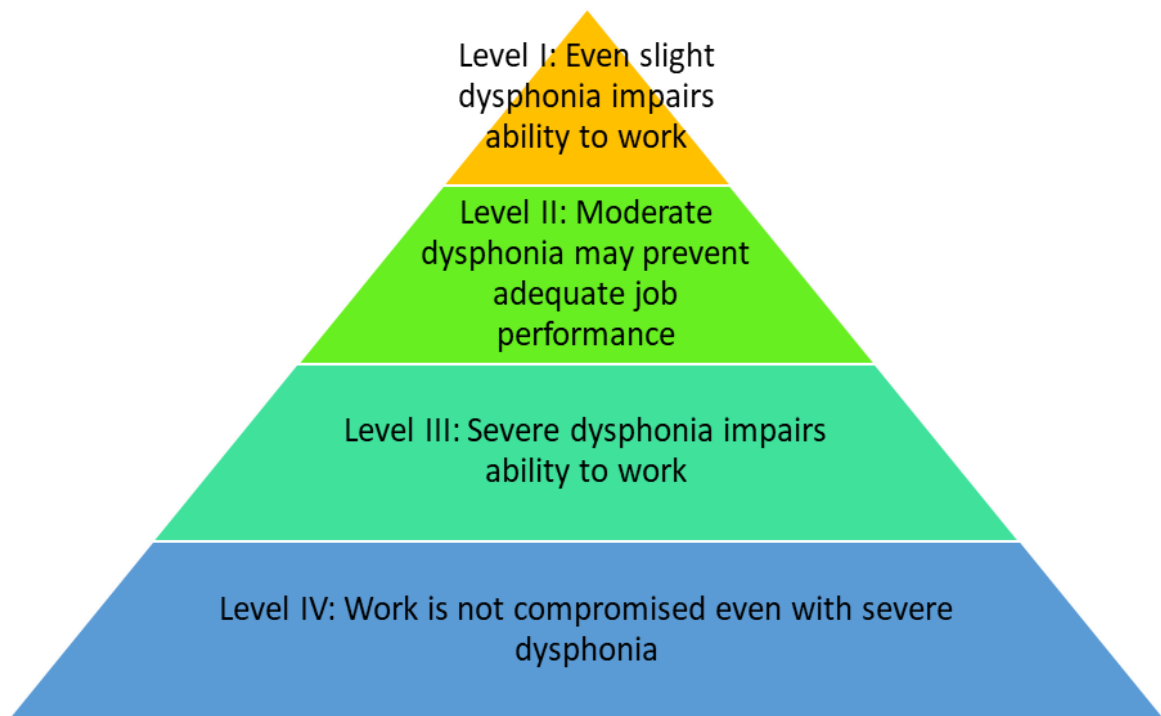


Figure 1.1 Pyramid of voice users, classified according to amount and demand of voice use (adapted from Koufman & Isaacson, 1991)

Vocal demand

Vocal demand includes the degree of vocal load in relation to the duration of voice use but also considers other facets of voice use, such as vocal and non-vocal factors (Pomaville et al., 2019).

Vocal Fatigue (VF)

VF is typically defined as a range of symptoms related to the overtaxing of the larynx, leading to a chronic subjective sensation of muscular tiredness of the voice that increases with voicing activity and progresses over time (Côrtes Gama et al., 2015; Franca & Wagner, 2015; Gaskill & Hetzel, 2017a; Pacheco & Behlau, 2019). Symptoms are irregularities and changes in the quality of voice, including limited frequency and intensity ranges (Côrtes Gama et al., 2015; Franca & Wagner, 2015; Gaskill & Hetzel, 2017; Pacheco & Behlau, 2019).

Vocal Hygiene Education (VHE)

VHE is a therapeutic and preventive approach based on behaviour modification thought to preserve and protect the vocal fold tissue and normal vibratory characteristics of the vocal folds (Faham et al., 2016; Pomaville et al., 2019). A VHE programme generally includes education regarding voice production, identification and elimination of phonotraumatic behaviours, emphasizes the importance of adequate hydration, and teaches strategies for voice production (Achey et al., 2016; Pomaville et al., 2019).

The International Classification of Functioning, Disability and Health (ICF)

The ICF is a framework for describing functioning and disability. It provides a basis for the definition and measurement of an individual's disability directly linked to their body functions and structures (impairment), activities (limitations) and participation (restrictions). When considering a voice disorder, especially for an OVU, their impairment greatly effects their level of limitation of work-related activities and thus causes many restrictions of participation in their everyday environment (WHO,2001).

CHAPTER 1

INTRODUCTION

Currently, more than one-third of the global workforce requires integrity of the voice to meet their occupational demands and are therefore considered occupational voice users [OVUs](Pomaville et al., 2019; Reed & Sims, 2017). Despite expected vocal load and demand, voice quality, and vocal sophistication differing between professions, all OVUs depend on vocal endurance (Rangarathnam et al., 2018). In other words, voice stability and maintenance is essential to the OVU as their voices are a critical component of their work (Munier & Farrell, 2016). Although OVUs' livelihoods depend partially or completely on their voice, the prevalence of voice disorders in OVUs is rising due to increased daily vocal demands. Continuous voice use and high vocal load, required occupationally, lead to voice problems (Achey et al., 2016; Pomaville et al., 2019; Porcaro et al., 2019; Rangarathnam et al., 2018). It has been established that OVUs are more at risk of experiencing voice symptoms and vocal problems when compared to the general working population and literature indicates a direct link between voice disorders and long-term professional voice use (Faham et al., 2016). Thus, managing vocal use is a vital skill all people must acquire, especially OVUs (Gaskill & Hetzel, 2017). Furthermore, research suggests that altered voice quality, especially for OVUs, may result in reduced productivity, work quality and professional performance, restricted participation in activities, limited vocal expression and emotional stress, as well as anxiety surrounding the risk of job loss with subsequent reduction in quality of life (Franca, 2013; Munier & Farrell, 2016; Piwowarczyk et al., 2012). Voice problems experienced by OVUs may therefore lead to difficulties for both employees and employers (Munier & Farrell, 2016; Piwowarczyk et al., 2012). Employers may experience increased employee turnover, absenteeism, and additional costs for substitute workers, medical treatment, and workers' compensation claims due to persisting voice disorders (Munier & Farrell, 2016; Piwowarczyk et al., 2012). As a result, voice management and vocal health of the OVU have received renewed attention (Devadas et al., 2019).

Research reports various vocal and non-vocal factors that contribute to OVUs' increased risk of acquiring a voice disorder. Non-vocal behaviours such as extreme

tensing of the jaw and neck musculature, clenching of teeth, and unnatural voicing postures could exert increased pressure on the laryngeal muscles leading to early fatigue (Devadas et al., 2019) as these behaviours necessitate increased subglottal pressure with a greater degree of glottal adduction (Devadas et al., 2019). Furthermore, internal biological factors within the OVU, such as pre-existing vocal fatigue, poor diet, dehydration, excessive caffeine, alcohol, smoking, difficulty hearing, and health concerns such as allergies, asthma, colds, sinus infections, and acid reflux all leading to regular intake of medication, correlate with increased frequency of voice disorders (Porcaro et al., 2019). Stress is also considered a contributing factor to voice disorders within OVUs. Under stressful work conditions, the precision of vocal fold movement may be directly altered by the state of mind and emotions of the OVU (Devadas et al., 2019). OVUs often have to perform their occupational tasks in less-than-optimal environments for vocal health (Pomaville et al., 2019). Environmental factors such as poor acoustic environments, high levels of excessive background noise, poor atmospheric humidity, exposure to environmental irritants, raising of the voice due to not having access to amplification systems, and inadequate vocal hygiene education (VHE) can also increase the risk of vocal fatigue and subsequent vocal trauma (Devadas et al., 2016; Franca & Wagner, 2015; Garzón García et al., 2017; Porcaro et al., 2019; Reed & Sims, 2017;).

Phonotraumatic patterns of vocal misuse and abuse such as constant throat clearing and coughing, inadequate vocal techniques, and regular telephone use directly affect the voice of the OVU. Continued voice use during periods of illness and not reserving sufficient time to recover after an illness, inflammation, or pre-existing voice disorder can also have detrimental vocal effects (Buckley et al., 2015; Côrtes Gama et al., 2015; Franca, 2013; Franca & Wagner, 2015; Gaskill & Hetzel, 2017; Rumbach, 2013). OVUs also expose their voices to daily high vocal demands, not always protecting their vocal systems from excessive vocal use (Cazden, 2017; Franca & Wagner, 2015). OVUs are required to use their voices for extended periods without rest, and frequently with increased levels of strain, loudness and varying pitch (Sezin et al., 2020). The vocal mechanism is capable of prolonged periods of rigorous use. Still, it requires adequate voice rest and recovery time to repair damage and reduce inflammation at a cellular level caused by abuse or misuse frequently encountered in OVUs (Buyukatalay et al., 2019; Gaskill & Hetzel, 2017).

Previous literature on OVUs such as professional TV and radio newsreaders and elite sports coaches found that most believed their job required extensive voice use and found their job to be vocally demanding (Buckley et al., 2015; Gunasekaran et al., 2016). Although OVUs recognized their occupational reliance on voice, none had sought help from healthcare professionals regarding experiences of voice symptoms or problems (Buckley et al., 2015). A theoretical “vocal effort loop” can be seen within OVUs, in which tensions within the vocal mechanism feed upon each other and grow, creating harmful vocal use patterns that can be very difficult to correct (Garzón García et al., 2017). These disruptions can impede OVUs’ ability to communicate effectively and ultimately perform occupational tasks (Reed & Sims, 2017). Research reveals that Vocal fatigue (VF) symptoms have a detrimental impact on the economic and vocational goals of OVUs, consequently also affecting their psychological well-being and quality of life (Aiken & Rumbach, 2018; Behlau & Oliveira, 2009; Porcaro et al., 2019; Rangarathnam et al., 2018).

In an effort to prevent voice disorders in OVUs, who face multiple risk factors and an ever-changing occupational world, the implementation of VHE programmes is endorsed (Faham et al., 2016; Pomaville et al., 2019). The main goals of VHE programmes are to educate individuals regarding practices to ensure vocal health, balancing muscles for optimal vocal production, and keeping the tissue free of lesions and pathology, particularly for OVUs (Faham et al., 2016; Pomaville et al., 2019). Thus, VHE is a therapeutic and preventive approach based on behaviour modification thought to preserve and protect the vocal fold tissue and normal vibratory characteristics of the vocal folds (Behlau & Oliveira, 2009; Faham et al., 2016; Pomaville et al., 2019). Consequently, these programmes require vocal modifications in the daily routines of OVUs to directly improve vocal health. Modifications can include education regarding voice production, identification and elimination of phonotraumatic behaviours, and the importance of adequate hydration and healthy strategies for voice production (Achey et al., 2016; Pomaville et al., 2019; Porcaro et al., 2019; Rangarathnam et al., 2018)

Although some OVUs receive various degrees of training on aspects of VH, their needs for vocal protection through VH practices are lifelong (Sezin et al., 2020). VHE programmes are frequently recommended for the prevention and treatment of voice disorders in OVUs, yet current research supporting the effectiveness of VHE

programmes is mixed (Pomaville et al., 2019). It may be widely assumed that elite OVUs, such as singers and those in the performing arts, would naturally acquire more information on the anatomy, physiology, and care of the vocal mechanism compared to other professions due to their particular dependence on voice quality (D'haeseleer et al., 2017; Latham et al., 2017). It has been suggested that a gap between acquiring voice care knowledge and the use of VH methods exists for OVUs (Franca & Wagner, 2015). Several studies have indicated that VHE has previously been insufficient in the curriculum of future OVUs (Bolbol et al., 2017; Fuentes-López et al., 2019; Jałowska et al., 2017; Neto & Meyer, 2017; Rumbach, 2013; Zuim et al., 2019). A study conducted on stage actors found that VH knowledge and vocal training did not significantly impact vocal quality measures (Rangarathnam et al., 2018). The authors concluded that although VHE may have some impact on voice quality, it is not considered the best preventive strategy for potential phonotrauma in this subject population (Rangarathnam et al., 2018b). Similarly, another study found that direct voice therapy showed more positive effects than VHE therapy in 50% to 60% of continuous measures of voice (Maximum phonation time, Jitter, etc.) (Rodríguez-Parra et al., 2011a). However, a study describing the voice quality of student teachers who received VHE training reported significantly poorer voice quality in the control group compared with that of the trained group ($p = .032$) (Nusseck et al., 2019). Previous literature on educators and journalists has shown that VHE programs can have a positive impact on voice quality through improved pre and post-test measures and awareness of voice use (Nusseck et al., 2019; Rodero et al., 2018). Other studies have found VHE is most effective for modifying vocal quality when used in combination with direct voice treatment (Liu et al., 2020). A study on primary school teachers indicated that a combination of VHE and resonant voice therapy significantly improved the voice quality of OVUs. Unfortunately, VHE is frequently reported to be insufficient in OVUs as evidenced by the expressed desire for more education and the continued high prevalence of voice problems (Buckley et al., 2015; Cazden, 2017; Gunasekaran et al., 2016). Thus, it is vital that the field of VHE and clinical facets thereof, such as voice reduction, be further explored so that OVUs can adequately be trained in how they can incorporate these novel methods of prevention into their daily routines.

Voice use reduction (VUR) (Van Der Merwe, 2004) is central to VH programmes, and can be used as a method to modify daily voice use aimed at directly enhancing vocal

health. Yet, literature reviews show the absence of a standard protocol for voice rest or reduction (Kaneko et al., 2017). Implementation and opinion on the type and duration of voice rest vary among clinicians (Kaneko et al., 2017). Complete voice rest is a controversial topic as some research argues the use thereof may lead to negative psychological effects on the client and deconditioning of the vocal apparatus as a finely tuned occupational tool (Kaneko et al., 2017). Therefore, complete voice rest of more than three days is presently limited to medical diagnoses of acute laryngitis, laryngeal trauma, and as a postoperative laryngeal surgery guideline (Kaneko et al., 2017). In contrast, modified voice rest and vocal conservation practices remain popular (Kaneko et al., 2017; Van Der Merwe, 2004). Interestingly, when total and modified voice rest were compared for recovery of lesions after laryngeal surgery, literature suggested that both approaches were equally effective, particularly in the reduction of lesion size (Kaneko et al., 2017). A structured programme of voice conservation, the VUR programme (Van Der Merwe, 2004), is linked to enhanced vocal health and quality, reduced vocal fatigue, and improvement in vocal-fold appearance after a controlled period of reduced voice use. The VUR programme permits VH by calculating the maximum units of voice use per day and per week in severe, moderate, and low VUR programmes. VUR may facilitate the process of tissue repair and precipitate the process of tissue re-epithelialization, which can be a useful preventative tool when treating voice disorders and vocal pathologies (Kaneko et al., 2017; Van Der Merwe, 2004).

When viewing an OVU within the ICF- Framework, with a focus on person-centered care, we must recognise how high vocal demands, phonotraumatic voice use, and inadequate knowledge of vocal care cumulatively leads to voice disorders in OVUs due to the effects on their bodily structures and functions (Rangarathnam et al., 2018, WHO, 2001). In turn, voice disorders have subsequent negative effects on OVUs activity and participation due to altered voice quality and vocal range affecting work performance and efficiency, job satisfaction, absenteeism, income, and psychosocial well-being in the OVU (Aiken & Rumbach, 2018; Faham et al., 2016; Porcaro et al., 2019; Rangarathnam et al., 2018; WHO, 2001). Although dysphonia and VF symptoms may have a detrimental impact on the vocational and economic goals of OVUs and therefore their quality of life, only a few OVUs report sufficient voice training or education as a preventative measure (Buckley et al., 2015; Buyukatalay et al., 2019;

Franca & Wagner, 2015; Gunasekaran et al., 2016; Munier & Farrell, 2016; Rumbach, 2013). It is therefore vital to gain information on the demands, perceptions, and knowledge reported by OVUs so that intervention strategies can be aimed to reduce these risks and innovative approaches can be explored. An essential part of clinical efforts to prevent voice disorders in OVUs is VHE. Yet, there is no current consensus about the efficacy of VHE (Faham et al., 2016) specifically on overall voice quality or vocal behaviours. Some studies have found that VHE has a minimal effect on vocal quality when used alone (Rangarathnam et al., 2018). Others, however, have demonstrated the positive effect VHE has on long-term vocal health (Nusseck et al., 2018; Rodero et al., 2018). Previous research has also argued that VHE is effective but only when combined with other direct treatment approaches (Liu et al., 2020). Most studies to date have also only focused on singular occupational groups namely, vocal performers and teachers (Pomaville et al., 2019; Porcaro et al., 2019). As a result, the literature should be critically appraised to determine the effect and/or perceived impact of vocal hygiene programs as an approach to improving voice quality for OVUs with or without voice disorders. When considering the use of VHE in OVUs for the prevention of voice disorders, our clinical approaches must strive to be innovative but first and foremost, remain evidence-based. Although a formalised approach to voice use reduction (VUR) has been suggested by van der Merwe (2004), the effect of this VUR approach is yet to be determined. Thus, the VUR programme (Van Der Merwe, 2004) must be tested for the potential to be a simple, accurate, and sustainable solution to individualised management of daily voice use in OVUs. In order to understand and improve vocal health through a tiered investigation, the following research questions are posed: *What is the evidence behind vocal hygiene programmes on voice quality in OVUs? What are the daily vocal demands, perceptions and knowledge reported by OVUs? And what is the effect of the VUR programme in OVUs?*

The chapters that follow will detail the following: The methodology of the 3 research studies/articles described in this thesis (Chapter 2). Study/Article 1 (Chapter 3), Study/Article 2 (Chapter 4), Study/Article 3 (Chapter 5) and in closing, the discussion, conclusion and clinical implications of the former chapters (Chapter 6).

CHAPTER 2

METHOD

2.1 Research objectives

Project aim

To understand and improve vocal health through a tiered investigation of vocal hygiene education, vocal demands, perceptions, knowledge, and voice use reduction in occupational voice users. The ICF Framework (WHO, 2001) was used as a guide and rationale while investigating all factors that influence voice related quality of life.

Research objectives

1. To critically appraise recent peer-reviewed, scientific evidence on the effect of vocal hygiene education on voice quality and function directly and indirectly measured by auditory-perceptual, acoustic, and self-report measures in PVUs
2. To describe daily vocal demands, perceptions, and knowledge as reported by OVUs in South Africa.
3. To determine the outcomes of the VUR programme (Van Der Merwe, 2004) on voice quality and vocal fatigue in OVUs.

2.2 Research studies

A tiered investigative approach was employed to achieve the main aim of the project. This was done through three research studies. The research methodologies for study one will be presented separately as this was a systematic review followed by the methods used for studies two and three respectively. All the studies have been submitted and/or accepted for publication in internationally accredited, peer-reviewed journals. The titles, objectives, and journals for publication of the three studies are summarised in Table 2.1.

Table 2.1. Summary of research studies

Study	1	2	3
Title	The effect of vocal hygiene education programs on voice quality in professional voice users: A systematic review	Self-reported vocal demands, perceptions and knowledge of occupational voice users in South Africa	The outcomes of The Voice Use Reduction Programme on voice quality and vocal fatigue in occupational voice users
Journals for publication	Journal of Speech, Language and Hearing Research	Journal of Voice	Folia Phoniatica et Logopaedica
Publication Status and DOI	Published (doi.org/10.1044/2022_JSLHR-22-00097)	Published (10.1016/j.jvoice.2023.01.032)	Submitted (Proof of submission: Appendix K)
Chapter in thesis	3	4	5

2.3 Study 1

2.3.1 Study design

A systematic review was completed by following the Preferred Reporting Items for Systematic Review and Meta-Analyses Protocols (PRISMA-P) (Shamseer et al., 2015). This study has been registered on PROSPERO, registration ID: CRD42021251934.

2.3.2 Study inclusion criteria

All studies selected were published in English, due to the authors' proficiency in English and because it is considered the universal language. Only original research data published within the last 10 years (2011–2021) were included in order to report on recent literature. All studies had to be scientific, human studies, and peer-reviewed

to be included. Reviews were excluded to prevent reporting bias. Participant groups included are PVUs such as, but not limited to, singers, actors, teachers, telemarketers, journalists, and group fitness instructors.

2.3.3 Search methods for identification of the studies

Five online electronic databases were searched on the 5th of February 2021. The databases used were MEDLINE, Scopus, Science Direct, PsycINFO, and PubMed, based on their relevance to medical literature. A consensus was reached by the three authors regarding search phrases and eligibility criteria. The final search phrase used consistently across the databases was “(vocal hygiene AND voice quality), (vocal hygiene education AND voice quality), (vocal health AND voice quality)” and received a total of 129 results across the databases.

To manage the data, the web-based software DistillerSR (Evidence Partners) was used. Duplicates found during the search were removed by DistillerSR (n=42). Thereafter, the primary researcher screened the remaining article abstracts for eligibility criteria. The reference lists of the included articles were scanned to identify related articles (n=6) and served as a secondary literature search. After this, all unrelated reports (n=70) were excluded. The remaining reports (n=23) were reviewed in full by the primary researcher to confirm all inclusion criteria were met by the primary researcher. To avoid bias, consensus was reached between the three authors regarding the final inclusion of the articles (n=23). Figure 2.1 represents the process of manuscript identification.

2.3.4 Data collection, extraction and evaluation

Each of the final 23 articles were analysed for the following data items: title; authors; year of publication; the country in which the study was conducted; the number of participants; participant age range, gender, occupation; the methodology; level of evidence; level of vocal hygiene education and validity of programme used; as well as auditory-perceptual, acoustic, and self-rating outcome measures, directly and indirectly, reflecting voice quality. DistillerSR was used to develop a custom data

extraction form from the study characteristics template which was used to record data items from the final selection. Data entry errors are minimized through the automated management of data (Shamseer et al., 2015). The American Speech-Language-Hearing Association's (ASHA) level of evidence rating scale and the quality indicators in the ASHA levels of evidence scheme were used to rate and score the articles (American Speech-Language-Hearing Association, 2004).

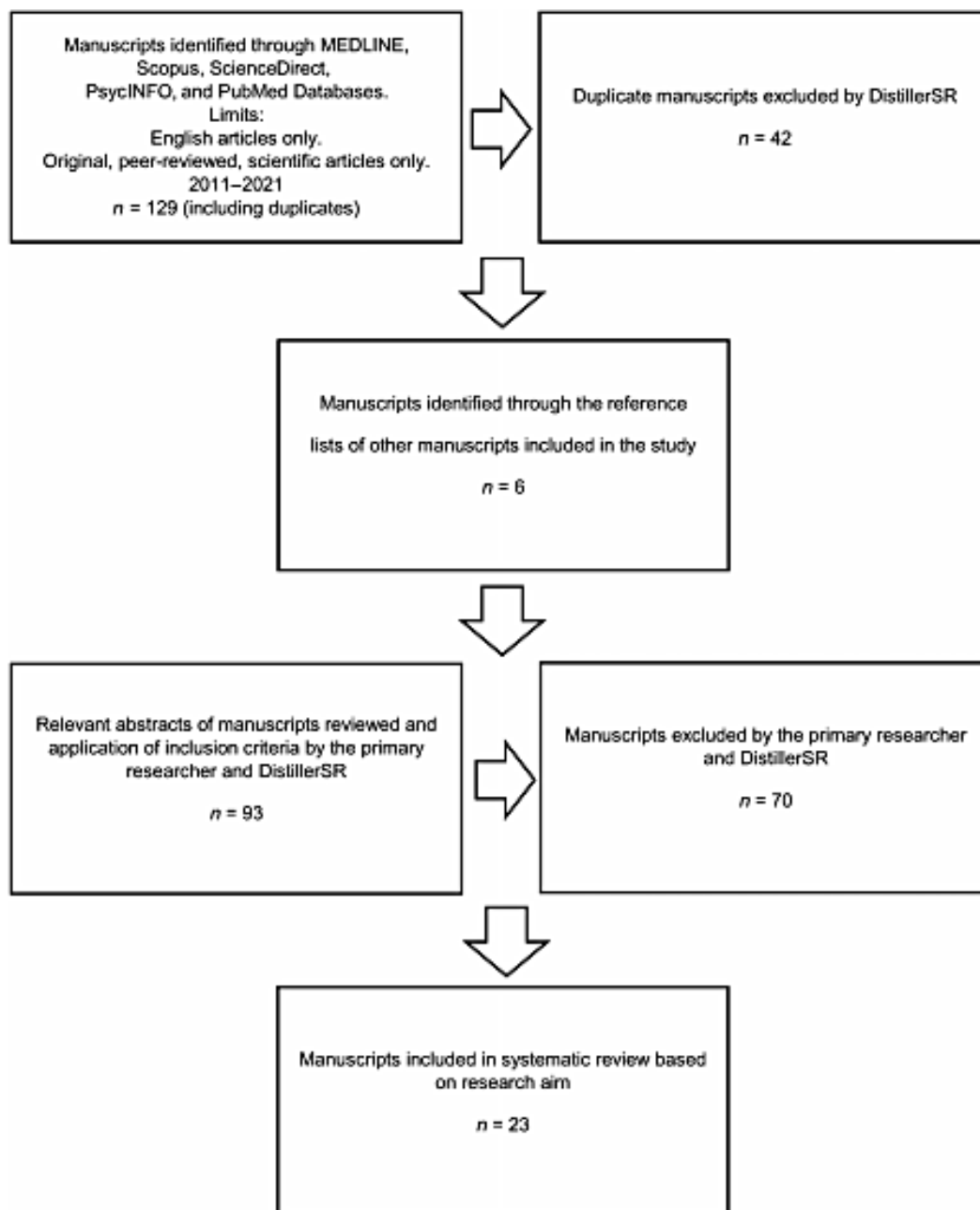


Figure 2.1 The process of manuscript identification.

2.3.5 Basic principles of Vocal Hygiene Education (VHE) programs in studies

Basic principles in VHE reviewed variably included education on the vocal mechanism, adequate hydration, vocally healthy diet (caffeine, medication, alcohol, spicy foods, dairy, etc.), posture and alignment, phonotraumatic vocal behaviours, reflux control, voice rest and ideal speaking environment (Bolbol et al., 2017; Faham et al., 2017; Liu et al., 2020; Nallamuthu et al., 2021; Nanjundeswaran et al., 2012; Nusseck et al., 2019; Pomaville et al., 2019; Porcaro et al., 2019; Rangarathnam et al., 2018; Richter et al., 2016; Rodríguez-Parra et al., 2011; Rumbach, 2013; Sezin et al., 2020).

2.3.6 Risk of bias

The Newcastle-Ottawa Scale (NOS) for case-control studies as well as the adapted version of the NOS for cross-sectional studies was used to evaluate the quality of non-randomized studies included in this review (Wells et al., 2014). Each study was independently appraised by the primary researcher while the two co-authors rated 20% of all included studies. The third author also mitigated situations of disagreement. The same articles were reviewed by all three authors and a 100% consensus was reached. A star rating system was employed when evaluating the methodologic quality using the NOS, which is based on three perspectives: selection, comparability, and exposure or outcome. Scores ranged from 0 stars (worst) to 8 stars (best).

2.3.5 Data synthesis

The data obtained were described and summarised using descriptive statistics. Inferential statistics were employed to analyse, organize, and synthesize the information extracted from the appraised articles to describe the findings quantitatively. Thematic synthesis was employed to extract and describe the qualitative findings.

2.4 Studies 2 and 3

2.4.1 Research design

Data were collected prospectively over a period of eight months. A descriptive, cross-sectional research design (Leedy & Ormrod, 2021) was used for Study 2. A within-subject, quasi-experimental, pre-test post-test research design (Leedy & Ormrod, 2021) was utilised for Study 3.

2.4.2 Research context

Data for the respective research studies were collected by snowball sampling OVUs living in the City of Tshwane, Gauteng. More than half (51.4%) of the Tshwane population are employed and 75% of those employees are found within the formal sector. Employment demographics show that the community services, finance, and trade sectors are the largest contributors to employment in Tshwane over the 2011 – 2015 period, all being considered as employment that requires OVUs (Regional eXplorer, 2015).

Various employers in Tshwane received invitational letters (Appendix A) via email requesting them to inquire whether OVUs in their employment would voluntarily participate in the proposed studies. For BMus Singing and BDrama students at the University of Pretoria, the Head of Departments (HoDs) and program coordinators received invitational letters via email requesting them to inquire whether students in their programs would voluntarily participate in the proposed studies. For lecturers at the University of Pretoria (UP), the research projects were advertised amongst various faculty HoDs via email. The researcher also gave a short presentation on what participation would entail for both studies at the various sites and handed out a pamphlet (Appendix B) on basic VH. Only OVUs and students who were interested in participating were asked to contact the researcher via email. All OVUs participated on a voluntary basis after informed consent (Appendix C) was obtained. Surveys (Appendix D) for Study 2 were distributed to participants and made available via email

link from the 26th of May to the 30th of June 2022. All assessments were conducted by the researcher at the Voice Laboratory at the University of Pretoria.

2.4.3 Research participants

A total of 102 male and female OVUs (call centre agents, teachers, lecturers, singing students, and performing arts students) were invited to complete the vocal demands survey using a snowball sampling technique for Study 2. The informed consent form and survey were sent via email as a link to the online survey; there was a 100% response rate. However, during the data cleaning process, it was found that although the Excel sheet contained 102 responses, two participants, after giving consent, did not complete any items on the questionnaire itself. These two participants were removed, giving a final sample size of 100. For Study 3, a total number of 30 male and female OVUs were invited to participate in this study from the initial 100 participants used in Study 2, using a random sampling technique.

Due to the study investigating an adult population, a minimum age of 18 years was set. Only OVUs who were not diagnosed with previous voice disorders by an otolaryngologist (ENT) or current infection or disease affecting vocal fold functioning were included, as this could cause possible bias due to previous knowledge acquired on vocal hygiene and voice use reduction or influence perceptual and acoustic results. Factors that may have influenced voice quality such as allergies, gastroesophageal reflux disease (GERD), sinusitis, were not regarded as exclusion criteria, but were taken into consideration.

2.4.4 Materials and Apparatus

Study 2

Vocal demands survey

The vocal demands survey consisted of a voice case history questionnaire, The Voice Handicap Index [VHI-10] (Rosen et al., 2004), and The Vocal Fatigue Index [VFI] (Nanjundeswaran et al., 2015) compiled as a single survey (Appendix D) on

Qualtrics^{xm}, an online survey platform. The voice case history questionnaire was completed by each OVU in order to obtain their biographic and demographic information for an accurate description of the sample population. The comprehensive case history questionnaire was completed to gather participants' voice histories regarding information, including age, profession, general health (GERD and allergies), medical history, vocal habits (smoking, alcohol consumption, and vocal abuse) and daily vocal use/load. Participants were asked to complete the voice handicap index (VHI-10) (Rosen et al., 2004) for comparison of self-perceived voice handicap. This ten-question scaled index aimed to identify and quantify voice handicaps in the participants. Participants rated 10 voice statements (e.g., "My voice problem upsets me") according to how applicable they are to them and their voice. Ratings are from 0 - 4, 0 being "never" and 4 being "always" (Rosen et al., 2004). Participants were asked to also complete the VFI (Nanjundeswaran et al., 2015) for comparison of self-perceived VF. The VFI is a scaled index used to determine whether VF is present. This also enabled the researcher to discriminate between participants with perceived dysphonia and participants with typical phonation (or phonation within normal limits). Participants rated 19 voice statements (e.g., "My voice feels tired when I talk more") according to how applicable they were to them and their voice. Ratings are from 0 - 4, 0 being "never" and 4 being "always". Three factors were examined relating to VF due to questions being separately aimed at 1. Tiredness of voice, 2. Physical discomfort and, 3. Improvement of symptoms with rest. A higher score for factors 1 and 2 indicated increased VF. Inversely, a higher score for factor 3 indicated decreased VF (Nanjundeswaran et al., 2015).

Study 3

Voice Use Reduction (VUR) Programme (Van Der Merwe, 2004).

The VUR Programme was used in order to identify all problem vocal behaviours and specify them in quantitative terms during the initial assessment. Quantifiable goals were set, and the participants were guided on how to apply the programme (Van Der Merwe, 2004). The programme consisted of voice use in all communication situations being quantified by the allocation of voice units (time allocated to voice use) to each

situation depending on how detrimental the effect of the situation is to the voice. The more detrimental the effect, the more voice units were assigned. The participants were only allowed to use a predetermined number of voice units per day and week. (Van Der Merwe, 2004). The VUR programme starts with severe voice use reduction and gradually, as the voice improves, progresses to stage two: moderate voice use reduction, and finally, ends in stage three: low voice use reduction. The duration of the stages depends on the improvement of the condition of the vocal folds, vocal quality, vocal fatigue, vocal effort, and laryngeal pain levels. As participants progressed through the levels of the VUR Programme, more voice-use units were allowed per day and week. The VUR Programme makes use of graphical displays of voice-use units for the client and clinician to review periodically during the progression of stages in the programme. A graph was prepared for each participant, indicating the voice use units on the y-axis and the number of weeks on the x-axis. Maximal daily voice use units were also indicated on the graph. The amount of voice use units used were then counted and marked on the graph. This assisted the participants in behaviour modification as it indicated the achievement of set goals (Van Der Merwe, 2004).

The GRBASI 4-point Rating Scale (Yamauchi, 2010).

The GRBASI 4-point rating scale was used to rate the perceptual quality of the participant's voices as they read the phonetically balanced rainbow passage (Fairbanks, 1960) (Appendix E). A trained listener's panel rated the Grade of hoarseness, Roughness, Breathiness, Asthenia, Strain, and Instability present in a participant's voice on a scale of 0 - 3, 0 being "Normal", 1 being "Slight", 2 being "Moderate", and 3 being "Severe". Audio recordings of the voices of each participant were made using a cellular phone (iPhone 12 Pro Max) in a MPEG-4 codec format. The phone was held at a fixed distance of 30 cm from the mouth to obtain the most consistent results across different participants and to obtain optimal quality recordings (Timmermans et al., 2004; Van Lierde et al., 2008). The perceptual analysis of voice was conducted within the soundproof Voice laboratory at the Department of Speech-Language Pathology and Audiology, University of Pretoria.

Table 2.2: GRBASI 4-point Rating Scale (Yamauchi et al., 2010)

Perceptual Quality		Description	Scoring
G	Grade	Degree of hoarseness of the voice	0= Normal 1= Slight 2= Moderate 3= Severe
R	Roughness	Impression of irregularity of vocal fold movement	
B	Breathiness	Degree of escaping air heard	
A	Asthenia	Degree of weakness	
S	Strain	Degree of strain	
I	Instability	Changes in voice quality over time	

The Computerized Speech Lab (CSL) 4300 hardware system

The acoustic data were gathered by means of the Computerized Speech Lab (CSL) 4300 hardware system. The CSL includes the Multi-Dimensional Voice Programme (MDVP) by Kay Elemetrics, designed to calculate, analyse, and graphically display numerous voice parameters recorded during sustained phonation.

Table 2.3: Acoustic Voice Parameters

Voice Parameters	Description
Maximum Phonation Time (MPT)	The longest possible phonation of the /a/ sound after maximum inspiration (Titze, 1994)
Jitter (%)	Defined by variation in frequency (number of cycles per unit of successive cycles) (Titze, 1994)
Shimmer (%)	Defined as short-term, cycle-to-cycle variability in vocal fold vibration amplitude (Titze, 1994)
Intensity (dB)	Sound pressure or loudness measured in decibel (Titze, 1994)
Frequency (Hz)	The change in state or cycle in a sound wave, of one cycle per second (Titze, 1994)

Voice Parameters	Description
Fundamental Frequency (Fo)	The lowest tone of harmonics heard in voice production known as the habitual frequency (Hz) (Titze, 1994)
Harmonics-to-noise Ratio (dB)	A measure that quantifies the amount of additive noise in the voice signal (Titze, 1994)

The CSL also includes the voice range profile measurement (VRP/phonetogram) which was used to graphically compare the vocal intensity range and the fundamental frequency. These various voice parameters were gathered in order to calculate the participant's voice quality with the Dysphonia Severity Index (DSI) (Wuyts et al., 2000). It is already known that multi-parametric measures are more suitable for the evaluation of voice quality than single measures (Wuyts et al., 2000). The DSI is a multi-parametric instrument designed to establish a purely objective measurement of perceived vocal quality in a quantitative format. The following set of voice measurements were taken into consideration when calculating the DSI (as per the equation below); maximum phonation time (MPT in seconds), highest frequency (Fo high in Hz), lowest intensity (I—low in dB), and jitter (%) (Wuyts et al., 2000).

$$DSI = 0.13 \times MPT(s) + 0.0053 \times Fo\text{-High (Hz)} - 0.26 \times I\text{-Low (dB)} - 1.18 \times Jitter (\%) + 12.4$$

The Vocal Fatigue Index (VFI) (Nanjundeswaran et al., 2015)

Participants were asked to complete the vocal fatigue index (VFI) (Nanjundeswaran et al., 2015) for comparison of self-perceived vocal fatigue. This 19-question scaled index aims to reliably identify and quantify vocal fatigue in the participants. This also allows the study to discriminate between participants with dysphonia and participants with typical phonation (or phonation within normal limits). Participants will rate 19 voice statements (e.g., “My voice feels tired when I talk more”) according to how applicable they are to them and their voice. Ratings are from 0-4, 0 being “never” and 4 being “always”. Three factors will be examined relating to vocal fatigue due to questions being separately aimed at 1. Tiredness of voice, 2. Physical discomfort and, 3. Improvement of symptoms with rest. A higher score for factors 1 and 2 indicates

increased vocal fatigue. Inversely, a higher score for factor 3 indicates decreased vocal fatigue (Nanjundeswaran et al., 2015).

2.4.5 Data collection procedures

IRB approval was obtained for all studies (HUM019/0321, Appendix F).

Survey Committee approval was obtained for Study 2 (Appendix G).

Study 2

Various employers and heads of departments (school of music and drama) were contacted and requested to inquire whether OVUs in their employment or students in their department would voluntarily participate in the proposed study. OVUs and students who were interested in participating were asked to provide their email addresses so that the online survey could be shared with them after the research study was announced by their employers/lecturers or after the primary researcher presented the study at the participants' place of work/class. All OVUs and students participated on a voluntary basis after informed consent was obtained. One hundred were selected via snowball sampling (where current participants recruit future potential participants from among their acquaintances) (Leedy & Ormrod, 2021). Upon written consent, surveys were distributed to participants. The survey was available via email link from the 26th of May to the 30th of June 2022.

Study 3

For Study 3, a total number of 30 male and female OVUs were invited to participate in this study from the initial 100 participants used in Study 2, using a random sampling technique. A case history questionnaire was completed to gather the participant's voice histories regarding the information including age, level of voice training, general health (reflux and allergies), medical history, and vocal habits (smoking, alcohol consumption, and vocal abuse). Participants were also asked to complete the vocal fatigue index (VFI) (Nanjundeswaran et al., 2015) twice for comparison of self-perceived vocal fatigue, before and after the VUR programme was implemented.

Participants received a comprehensive voice assessment in order to establish a baseline for vocal quality. All acoustic analysis and perceptual data were recorded on the Protocol Form (Appendix H) COVID-19 regulations were strictly adhered to at all times by wearing masks, social distancing, and regular hand washing and sanitizing all equipment used by the researcher and participants. Perceptual and acoustic voice parameters were measured before and after the VUR programme was implemented. All perceptual analysis of voice was conducted within a soundproof voice laboratory by the researcher.

The GRBASI 4-point rating scale (Yamauchi et al., 2010) was used to rate the perceptual quality of the participants' voices as they read the phonetically balanced rainbow passage (Fairbanks, 1960). Audio recordings of the voices of each participant were made using a cellular phone (iPhone 12 Pro Max) in a MPEG-4 codec format. The phone was held at a fixed distance of 10 cm from the mouth to obtain the most consistent results across different participants and to obtain optimal quality recordings (Lierde et al., 2010). A listeners panel of five qualified speech-language therapists was used to score the perceptual data as a previous study on the reliability in perceptual analysis of voice quality, found that even when a small number of listeners are used, inter-rater reliability remains high (Bele, 2005). The voice recordings were presented in random order to remove bias. Each member of the panel of listeners gave a rating for each component of the GRBASI scale and consensus was reached by a majority vote for each component. Thus, the use of an uneven number of listeners eliminated the possibility of a split vote. Due to the listeners panel being blind to which recordings were from the pre- or post-test groups, this increased the objectivity and reliability of the rating of perceptual measures. Majority consensus was reached through independent scoring in a quiet room, in one session.

The maximum phonation time (MPT) of all participants was taken using the steady state vowel /a/ after a maximum inspiration and the best time over three repetitions was recorded. Thereafter, an s/z ratio was calculated by producing the voiceless /s/ and voiced /z/ on maximal inspiratory effort for as long as possible. The best of three attempts was recorded. MPT was considered normal when greater than or equal to 15.1 seconds (Goy et al., 2013).

MDVP and the VRP of the CSL MODEL 4105B; (KayPENTAX) was conducted on all the participants in a sound-proof voice laboratory. Acoustic analysis of the voice was accomplished using a microphone set 10cm away from the mouth. The MDVP was used to evaluate the jitter (*jitt* %), shimmer (*shim* %), fundamental frequency variation (vF0) and harmonic-to-noise ratio (*HNR*) of each participant. The VRP depicted the participant's minimum and maximum volume and pitch capacities across their vocal range. The dysphonia severity index (*DSI*), a multi-parametric tool, was employed to generate an objective vocal quality score based on acoustic results (Hakkesteeft et al., 2010). Adult norms indicate that values of $DSI > 0$ are normal, while values in the range of $-5 < DSI < 0$ may be considered either severely, moderately or mildly dysphonic. These norms were used as a guideline (Yu et al., 2001).

Participants were asked to use the Voice Use Reduction (VUR) programme (Appendix I) daily for eight weeks. The VUR programme is normally started at stage one: severe voice use reduction and gradually, as the voice improves, progresses to stage two: moderate voice use reduction and finally, ends in stage three: low voice use reduction. In this study there were no participants that presented with a current diagnosis of organic vocal pathology and therefore the VUR was started at moderate voice use reduction as severe voice use reduction is intended for patients with vocal pathology (Van Der Merwe, 2004). The participants were given the Moderate voice use reduction and Low voice use reduction infographics to better understand implementation (Appendix J and K). The duration of the stages was dependent on the improvement of the condition of the vocal folds, vocal quality, vocal fatigue, vocal effort and laryngeal pain levels. When progressing through the levels of the VUR Programme, more voice-use units were allowed per day and week. Progress was tracked through the use of the VUR Programme graphs, perceptual and acoustic voice analysis pre-and post-test and the administration of the VFI before and after the duration of the VUR programme. All assessments were conducted by the researcher at the Voice Laboratory at the University of Pretoria.

2.5 Data processing and analysis

Data processing involves the preparation of data for analysis, by categorizing it in an orderly manner. This was achieved by coding the raw data in a quantifiable way. For

Studies 2 and 3 participants' background information, pre-and post-test perceptual, acoustic and VFI outcomes were recorded in an MS Excel sheet as quantitative data for statistical analysis. The Statistical Package for Social Sciences (SPSS) software programme version 28 was used for all data analyses in Studies 2 and 3. Data analysis procedures for each study are described below.

Study 2

Descriptive statistics, such as means, standard deviations and percentages, and inferential statistics, are reported in this study. For the VHI, the 10 items of the VHI instrument were combined by adding the scores for the 10 items, and for the three factors of the VFI, for Factor 1 items 1 to 11 were combined, for Factor 2 the next 5 items were combined and for Factor 3 the last 3 items were combined of the total of the 19 VFI items. Since these constructs were continuous variables, normality had to be tested. The Shapiro-Wilk test was used to test for differences from normality for all the continuous variables in the study with a p -value greater than 0.05 indicating normality. Since many of the p -values are less than 0.05 for many of the continuous variables considered in this study, normality could not be established for all variables and, accordingly, non-parametric methods were used, specifically, the non-parametric Spearman correlation (r_s) was used to test for correlations between various variables. In addition, since not all variables are normally distributed, the median (Mdn) and interquartile range (IQR) are reported along with the mean (M) and standard deviation (SD). For reporting the results, note that, since the sample size equalled 100 exactly, the frequencies and percentages are equal and, for brevity, only percentages are reported. Three multiple linear regression models were built using the same predictors, but with the dependent variable being VHI-10 (Model 1), VFI Factor 1 (Model 2), and VFI Factor 2 (Model 3), respectively. For all three models, nine predictors were used, namely; allergies, post-nasal drip, oesophageal reflux, hoarseness of voice, roughness of voice, VF, intake of liquid caffeine and smoking. The ninth predictor indicated how often participants use their voice for work during a week. For each model, a stepwise multiple linear regression was performed, and the assumptions for this type of analysis (e.g., Normality of residuals) were checked, and it was confirmed

that all the necessary assumptions were met for all three models before building the models.

Study 3

Since the sample size was less than 50, the Shapiro-Wilk's statistic was used instead of the Kolmogorov-Smirnov statistic to test for normality. If the p-value is greater than 0.05, then normality is assumed. Since many of the p-values are less than 0.05, for many of the continuous variables considered in this study, normality cannot be assumed for all variables, and, accordingly, nonparametric methods were used. For continuous variables, the Wilcoxon signed-rank test and the Mann-Whitney test were used to determine statistically significant differences for related/dependent and unrelated/independent samples, respectively. For categorical variables, the McNemar's test was used to determine whether the frequencies differed statistically significantly from each other between the pre-and post-test data. For Likert-type ordinal data (the GRBASI), the Mann-Whitney test was used to test for statistically significant differences between unrelated/independent samples. In addition, since not all variables are normally distributed, the median (*Mdn*) and interquartile range (*IQR*) are reported along with the mean (*M*) and standard deviation (*SD*).

2.6 Ethical considerations

Permission to conduct research

IRB approval was obtained for this research project (Appendix F, HUM019/0321). Ethical clearance was obtained from the Humanities Research Ethics Committee and Survey Committee, University of Pretoria (Appendix G). Ethical considerations were in place in order to protect the rights and welfare of the participants who were involved in the study (Leedy & Ormrod, 2021).

Protection from harm and non-maleficence

Risk related to participating in research should never surpass the risks of normal daily living (Leedy & Ormrod, 2021). Research participants were not subjected to physical

or psychological risk, stress, financial cost, or embarrassment for these studies. Participants were respected at all times. The researcher, a qualified trained speech-language therapist, collected all of the data. This was clearly indicated, written and verbally, when informed consent was obtained (Leedy & Ormrod, 2021).

Beneficence

The benefits of participation, however, involved the assessment and identification of any vocal handicap, vocal fatigue, vocal abuse, and misuse patterns or dysphonia resulting in the necessary referrals for intervention and appropriate support thereto. All participants received guidance in VH practices and environmental modifications to prevent voice disorders, focusing on voice use reduction (as detailed in Chapter 5) (Leedy & Ormrod, 2021).

Voluntary participation and informed consent

Voluntary participation and informed consent prior to data collection are two of the most important ethical considerations to which a research project should adhere (Leedy & Ormrod, 2021). Participants were informed about the nature of the studies, their level of involvement, and the process of data collection prior to obtaining informed consent. Each participant received an information leaflet and informed consent letter explaining the nature and process of the studies and requesting their involvement in the research studies (Appendix C). Participants were made aware that they had the right to withdraw from the studies at any time, without any negative consequences (Leedy & Ormrod, 2021). Permission letters were sent to each employer, HoD, and programme coordinator, requesting permission to approach OVUs and students for participation (Appendix A). Data collection commenced after permission and written informed consent had been obtained.

Right to privacy and confidentiality

In Studies 2 and 3 the researcher assigned a number to each participant to ensure confidentiality. No identifying information was documented (Leedy & Ormrod, 2021).

Participant numbers were used to match the background information to the outcomes obtained using the Vocal Demands Survey, perceptual and acoustic measures, and VFI. In Study 3, there was a high degree of contact between the participants and the researcher. Consequently, anonymity cannot be guaranteed (Pole & Hillyard, 2016). Nonetheless, the privacy of the participants was respected by keeping the nature, quality, and results of the participants' performance strictly confidential (Leedy & Ormrod, 2021). The data obtained was only accessible to the researcher.

Storing of Data

Data will be stored electronically for 15 years in a code-protected room (room 3-19) within the Communication Pathology building, University of Pretoria as well as in the UP-data repository. All data will thus be stored on password- and user-protected UP drives. Figshare will be used in pertaining all figures.

2.7 Validity and Reliability

In this research project validity and reliability were maintained through the use of standardised tools and measures. In study one, the data collection procedure included the American Speech-Language-Hearing Association's (ASHA) level of evidence rating scale and the quality indicators in the ASHA levels of evidence scheme to rate and score the articles (American Speech-Language-Hearing Association, 2004). To ensure the reliability of rating risk of bias the Newcastle-Ottawa Scale (NOS) for case-control studies as well as the adapted version of the NOS for cross-sectional studies was used to evaluate the quality of non-randomized studies included in this review (Wells et al., 2014). Between studies two and three, The Voice Handicap Index (VHI-10) (Rosen et al., 2004), and The Vocal Fatigue Index (VFI) (Nanjundeswaran et al., 2015) were used to reliably identify and quantify vocal handicap and fatigue in the participants. In study three, The GRBASI 4-point rating scale and the use of a qualified listener's panel was used to reliably rate the perceptual quality of the participant's voices. The acoustic data were gathered by means of the Computerized Speech Lab (CSL) 4300 hardware system. The CSL includes the Multi-Dimensional Voice

Programme (MDVP) by Kay Elemetrics, designed to calculate, analyse, and graphically display numerous voice parameters recorded during sustained phonation. The CSL also includes the voice range profile measurement (VRP/phonetogram) which was used to graphically compare the vocal intensity range and the fundamental frequency. These various voice parameters were gathered in order to calculate the participant's voice quality with the Dysphonia Severity Index (DSI) (Wuyts et al., 2000). It is already known that multi-parametric measures are more suitable for the evaluation of voice quality than single measures. (Wuyts et al., 2000) The DSI is a multi-parametric instrument designed to establish a purely objective measurement of perceived vocal quality in a quantitative format.

CHAPTER 3

THE EFFECT OF VOCAL HYGIENE EDUCATION PROGRAMS ON VOICE QUALITY IN PROFESSIONAL VOICE USERS: A SYSTEMATIC REVIEW

Authors: Vermeulen, R., du Toit, M., van Lierde, K., & van der Linde,

Journal: Journal of Speech, Language and Hearing Research

Impact factor: 2.674

Date accepted: 14 August 2022

Proof of acceptance: Appendix L

Publication: Volume 65, Issue 12, December 2022, Pages: 4700-4713

DOI: https://doi.org/10.1044/2022_JSLHR-22-00097

Note: This article was edited in accordance with the editorial specifications of the journal and may differ from the editorial style of the rest of this document.

1.1 Abstract

Purpose. The study aimed to critically appraise recent peer-reviewed, scientific evidence on the effect of vocal hygiene education on voice quality and function directly and indirectly measured by auditory-perceptual, acoustic, and self-report measures in professional voice users.

Method. A systematic review was conducted utilising the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA-P) guidelines. Five databases were searched using the keywords “vocal hygiene”, “vocal hygiene education”, “vocal health”, “vocal quality”, and “voice quality” with Boolean phrases “AND” and “OR”. Twenty-three studies that met the eligibility criteria were included. Scoring was based on American Speech-Language-Hearing Association’s levels of evidence and quality indicators, as well as the Newcastle Ottawa Scale (NOS) for assessing the risk of bias.

Results. Four studies (17%) linked low awareness of vocal hygiene or insufficient vocal hygiene education to self-reported acute and chronic voice symptoms as well as

a greater perception of voice handicap amongst professional voice users. Numerous studies ($n = 10$; 43%) showed adequate voice training or vocal hygiene education was linked to positive voice outcomes. Six studies (6,26%) however, demonstrated that vocal hygiene education is more effective when combined with direct voice therapy. When vocal hygiene education is presented in isolation the superiority of a direct voice therapy approach, with or without vocal hygiene education, is seen over a vocal hygiene education program alone (indirect treatment).

Conclusions. Recent literature demonstrates mixed results obtained through auditory-perceptual, acoustic, and self-rating measures on the effects of vocal hygiene instruction on vocal quality and function in professional voice users. However, the compelling positive outcomes presented do warrant the implementation of vocal hygiene education programs in combination with direct voice therapy for professional voice users.

Key Words: PRISMA-P; Professional voice users; Systematic review; Vocal hygiene education; Voice quality.

1.2 Introduction

Currently, more than one-third of the global workforce requires integrity of the voice to meet their occupational demands and are therefore considered professional voice users (PVUs) (Pomaville et al., 2019; Reed & Sims, 2017; Wingate et al., 2007). PVUs are required to use their voices for extended periods, frequently with increased loudness and varying pitch, (Sezin et al., 2020), and often have to perform their occupational tasks in environments that are less than optimal for vocal health (Pomaville et al., 2019). This makes PVUs vulnerable to phonotrauma (Sezin et al., 2020; Van Lierde et al., 2008).

Although vocal load, voice quality, and vocal sophistication may differ within and across professions, all PVUs depend on vocal endurance (Rangarathnam et al., 2018). High vocal demands, phonotraumatic voice use, and inadequate knowledge on vocal care can cumulatively lead to voice disorders in PVUs (Rangarathnam et al., 2018). Recent literature indicates a direct link between voice disorders and long-term professional voice use (Faham et al., 2016). In turn, voice disorders have subsequent

negative effects on voice quality and vocal range (Porcaro et al., 2019), work performance, efficiency, job satisfaction, absenteeism, loss of income (Faham et al., 2016), and psychosocial well-being in the PVU (Aiken & Rumbach, 2018; Behlau & Oliveira, 2009; Rangarathnam et al., 2018).

To prevent voice disorders in PVUs, the implementation of vocal hygiene education (VHE) program is endorsed. VHE is a therapeutic and preventive approach based on behaviour modification thought to preserve and protect the vocal fold tissue and normal vibratory characteristics of the vocal folds (Behlau & Oliveira, 2009; Faham et al., 2016; Pomaville et al., 2019). A VHE program generally includes education regarding voice production, identification and elimination of phonotraumatic behaviours, emphasise the importance of adequate hydration, and teaches strategies for voice production (Achey et al., 2016; Behlau & Oliveira, 2009; Pomaville et al., 2019), particularly for PVUs (Behlau & Oliveira, 2009; Pomaville et al., 2019). Although some PVUs are briefly trained on aspects of VHE, their needs for vocal health protection, vocal hygiene, and vocal techniques are lifelong (Sezin et al., 2020). A VHE program is frequently recommended for the prevention and treatment of voice disorders in PVUs, yet current research supporting the effectiveness of a VHE program is mixed (Pomaville et al., 2019). Some studies have found that VHE has minimal effect on vocal quality when used alone (Rangarathnam et al., 2018b; Rodríguez-Parra et al., 2011). Others, however, have demonstrated the positive effect VHE has on long term vocal health (Nusseck et al., 2018; Rodero et al., 2018). Previous research has also argued that VHE is effective but only when combined with other direct treatment approaches (Liu et al., 2020). Thus, further exploration is needed to find conclusive results on the effects of VHE on voice quality in PVUs with and without voice disorders.

It may be widely assumed that PVUs, such as singers and those in the performing arts, would naturally acquire more information on the anatomy, physiology, and care of the vocal mechanism compared to other professions due to their particular dependence on voice quality (D'haeseleer et al., 2017; Hackworth, 2006; Latham et al., 2017). Several studies have explored the type and amount of VHE that students of various vocal performance professions receive (D'haeseleer et al., 2017; Hackworth, 2006; Latham et al., 2017). Ultimately, research indicates that VHE has

previously been insufficient in the curriculum of future PVUs (Bolbol et al., 2017; Fuentes-López et al., 2019; Jałowska et al., 2017; Neto & Meyer, 2017; Rumbach, 2013; Zuim et al., 2019). A study conducted on stage actors found that vocal hygiene knowledge and vocal training did not significantly impact vocal quality measures (Rangarathnam et al., 2018). The authors concluded that although VHE may have some impact on voice quality, it is not considered the best preventive strategy for potential phonotrauma in this subject population (Rangarathnam et al., 2018). Similarly, another study found that direct voice therapy showed more positive effects than VHE therapy in 50% to 60% of continuous measures of voice (Maximum phonation time, Maximum exhalation time, Maximum phonation time during connected speech, Jitter, Well-being, Self-voice, Hygiene, and Anxiety) (Rodríguez-Parra et al., 2011a).

A study describing the voice quality of student teachers who received VHE training reported poorer voice quality in the control group compared with that of the trained group, whose voice quality improved significantly ($p = .032$) (Nusseck et al., 2019). Also, the trained teachers significantly increased in awareness of voice use and their mental health compared to the nontrained group (Nusseck et al., 2019). VHE programs can thus have a positive impact on the voice quality of student teachers (Nusseck et al., 2019). Similarly, journalism students who attended a VHE course achieved improved vocal quality when comparing pre and post-test measures (Rodero et al., 2018).

Other studies found VHE effective for modifying vocal quality when combined with direct voice treatment (Liu et al., 2020). A study on primary school teachers indicated that a combination of VHE and resonant voice therapy significantly improved the voice quality of PVUs whereas the PVUs who only received VHE did not show significant improvement in voice quality (Liu et al., 2020). Although VHE did not consistently yield improvement of vocal quality studies have shown that PVUs and future PVUs still recognize the importance of voice care and are interested in VHE programs (Barnes-Burroughs & Rodriguez, 2012; Braun-Janzen & Zeine, 2009). Mixed results found on the effect of vocal hygiene programs on vocal quality warrant a systematic review to critically appraise recent evidence. Most studies to date have also only focused on singular occupational groups namely, vocal performers and teachers (Pomaville et al.,

2019; Porcaro et al., 2019). Currently, there is no consensus about the efficacy of voice education and voice hygiene education specifically (Faham et al., 2016) on overall voice quality or vocal behaviors. As a result, the literature should be critically appraised to determine the effect and/or perceived impact of vocal hygiene programs as an approach to improving voice quality for PVUs.

1.3 Method

Aim

This study aims to critically appraise recent peer-reviewed, scientific evidence on the effect of vocal hygiene education through perceived changes in professional voice users' voice quality over time (PICO).

Study design

A systematic review was completed by following the Preferred Reporting Items for Systematic Review and Meta-Analyses Protocols (PRISMA-P) (Shamseer et al., 2015). This study has been registered on PROSPERO, registration ID: CRD42021251934.

Study inclusion criteria

All studies selected were published in English, due to the authors' proficiency in English and because it is considered the universal language. Only original research data published within the last 10 years (2011–2021) were included in order to report on recent literature. All studies had to be scientific, human studies, and peer-reviewed to be included. Reviews were excluded to prevent reporting bias. Participant groups included are PVUs such as, but not limited to, singers, actors, teachers, telemarketers, journalists, and group fitness instructors.

Search methods for identification of the studies

Five online electronic databases were searched on the 5th of February 2021. The databases used were MEDLINE, Scopus, Science Direct, PsycINFO, and PubMed, based on their relevance to medical literature. A consensus was reached by the three authors regarding search phrases and eligibility criteria. The final search phrase used consistently across the databases was “(vocal hygiene AND voice quality), (vocal hygiene education AND voice quality), (vocal health AND voice quality)” and received a total of 129 results across the databases.

To manage the data, the web-based software DistillerSR (Evidence Partners) was used. Duplicates found during the search were removed by DistillerSR (n = 42). Thereafter, the primary researcher screened the remaining article abstracts for eligibility criteria. The reference lists of the included articles were scanned to identify related articles (n = 6) and served as a secondary literature search. After this, all unrelated reports (n = 70) were excluded. The remaining reports (n = 23) were reviewed in full by the primary researcher to confirm all inclusion criteria were met by the primary researcher. To avoid bias, consensus was reached between the three authors regarding the final inclusion of the articles (n = 23). Figure 1 represents the process of manuscript identification.

Data collection, extraction, and evaluation

Each of the final 23 articles was analyzed for the following data items: title; authors; year of publication; the country in which the study was conducted; the number of participants; participant age range, gender, occupation; the methodology; level of evidence; level of vocal hygiene education and validity of programme used; as well as auditory-perceptual, acoustic, and self-rating outcome measures, directly and indirectly, reflecting voice quality. DistillerSR was used to develop a custom data extraction form from the study characteristics template which was used to record data items from the final selection. Data entry errors are minimized through the automated management of data (Shamseer et al., 2015). The American Speech-Language-Hearing Association’s (ASHA) level of evidence rating scale and the quality indicators

in the ASHA levels of evidence scheme were used to rate and score the articles (American Speech-Language-Hearing Association, 2004).

Basic principles of Vocal Hygiene Education (VHE) programs in studies

Basic principles in VHE reviewed variably included education on the vocal mechanism, adequate hydration, vocally healthy diet (caffeine, medication, alcohol, spicy foods, dairy, etc.), posture and alignment, phonotraumatic vocal behaviors, reflux control, voice rest and ideal speaking environment (Bolbol et al., 2017; Faham et al., 2017; Liu et al., 2020; Nallamuthu et al., 2021; Nanjundeswaran et al., 2012; Nusseck et al., 2019; Pomaville et al., 2019; Porcaro et al., 2019; Rangarathnam et al., 2018; Richter et al., 2016; Rodríguez-Parra et al., 2011; Rumbach, 2013; Sezin et al., 2020).

Risk of bias

The Newcastle-Ottawa Scale (NOS) for case-control studies as well as the adapted version of the NOS for cross-sectional studies was used to evaluate the quality of non-randomized studies included in this review (Wells et al., 2014). Each study was independently appraised by the primary researcher while the two co-authors rated 20% of all included studies. The third author also mitigated situations of disagreement. The same articles were reviewed by all three authors and a 100% consensus was reached. A star rating system was employed when evaluating the methodologic quality using the NOS, which is based on three perspectives: selection, comparability, and exposure or outcome. Scores ranged from 0 stars (worst) to 8 stars (best).

Data synthesis

The data obtained were described and summarised using descriptive statistics. Inferential statistics were employed to analyze, organize, and synthesize the information extracted from the appraised articles to describe the findings quantitatively. Thematic synthesis was employed to extract and describe the qualitative findings.

3.4 Results

The study characteristics and main findings are summarized and presented in Table 1.2. Seventeen of the studies (n = 17; 74%) were conducted in high-income countries (HICs), such as the United States (n = 9; 39%), Australia (n = 1; 4%), Chile (n = 1; 4%), Spain (n = 2; 8,6%), Poland (n = 1; 4%), Sweden (n = 1; 4%), and Germany (n = 2; 8%). Six studies were conducted in upper (UMICs) and lower-middle-income countries (LMICs) including Brazil (n = 2; 8,6%), Turkey (n = 1; 4%), China (n = 1; 4%), Egypt (n = 1; 4%) and India (n = 1; 4%). Participants' ages ranged from 16 to 65 years across the selected articles. Ten studies (43%) were observational cross-sectional survey-based studies in design. The rest of the study designs (n = 13; 56%) were observational cohort studies (n = 6; 26%) experimental randomized control trial studies (n = 6; 26%) and one (4%) experimental within-subject study. Eleven studies (48%) achieved a high evidence rating (IIb), while twelve studies (52%) achieved a low evidence rating (III) according to ASHA's levels of evidence (Table 1.2) (American Speech-Language-Hearing Association, 2004).

Risk of bias

The risk of bias assessment is summarized and presented in Table 1.1. When evaluating all studies, variability in the methodologic quality rating is noted (Poor – two studies; Fair – twelve studies; High – nine studies). Across all studies, the average rating (six stars) indicates a fair methodologic quality across all studies included (Table 1.1).

Table 1.1: Newcastle-Ottawa Scale (NOS) for assessing the risk of bias (Higgins et al., 2011)

Reference	Selection	Comparability	Outcome/ Exposure	Total Quality
<i>NOS for cohort studies</i>				
(Nallamuthu et al., 2021)	**	**	****	8
(Rangarathnam et al., 2018)	*	-	***	4
<i>NOS for case-controlled studies</i>				

(Rodríguez-Parra et al., 2011)	*	*	***	7
(Jałowska et al., 2017) & (Pabon et al., 2014)	**	*	**	5
(Richter et al., 2016) & (Rodero et al., 2018)	***	*	***	7
(Sezin et al., 2020) & (Liu et al., 2020)	***	*	**	6
(Nusseck et al., 2019)	*	*	**	4
NOS for cross-sectional studies				
(Neto & Meyer, 2017) & (Rumbach, 2013)	**	-	*	3
(Bolbol et al., 2017)	****	*	***	8
(Achey et al., 2016)	***	-	**	5
(Zuim et al., 2019) & (Latham et al., 2017)	****	-	**	6
(Fuentes-López et al., 2019)	**	-	**	4
(Faham et al., 2016) , (Coelho et al., 2020) & (Porcaro et al., 2019)	****	*	**	7
(Cruz et al., 2019) & (Pomaville et al., 2019)	**	*	**	5
(Nanjundeswaran et al., 2012)	*****	*	*	7

*Abbreviation: NOS, Newcastle Ottawa Scale

Results as per VHE on voice quality

Studies using Questionnaires and self-rating scales

Four studies (17%) found that self-reported acute and chronic voice symptoms, (of which vocal fatigue was the most prevalent (Neto & Meyer, 2017), as well as a greater perception of voice handicap, was linked to respondents reported low awareness of VHE and/or PVUs not having received sufficient voice training (Coelho et al., 2020; Cruz et al., 2019; Neto & Meyer, 2017; Rumbach, 2013). The frequency of unfavorable vocal hygiene habits, such as phonotraumatic behaviors correlated to the number of vocal symptoms reported by PVUs (Fuentes-López et al., 2019). According to PVUs in one study (4%), using their voice in noisy environments and talking without taking breaks were both associated with the presence of vocal symptoms, such as “tense or tired voice”, “dry throat and mouth” and “needing to clear their throat” (Fuentes-López et al., 2019). Another link was seen (n = 3; 13%) between PVUs who self-reported adequate voice training or those who received VHE and positive voice quality outcomes (Bolbol et al., 2017; Faham et al., 2016; Zuim et al., 2019). One study (n = 1,4%) found that PVUs strongly agree that vocal physiology and vocal health should be taught in the graduate voice curriculum and that knowledge of vocal health might

help PVUs limit injuries. Overall, the amount and quality of the instruction provided in respective institutions was perceived positively. However, there were several perceived barriers to incorporating vocal health education into graduate programs such as limited time in the curriculum, lack of financial support, and lack of availability of a medical professional to teach (Latham et al., 2017). The effect of vocal hygiene in one study ($n = 1,4\%$) on PVUs' willingness to implement vocally hygienic behaviors was positively related and statistically significant ($d \geq 0.80$) (Porcaro et al., 2019). An increase in the perceived desire to engage in vocal hygiene behaviors was seen for nearly 90% of the targeted vocal hygiene behaviors (Porcaro et al., 2019). Another study (4%) found a statistically significant improvement in PVUs' knowledge regarding the larynx, voice production, and vocal hygiene after the implementation of a VHE program (Pomaville et al., 2019). At post-test PVUs demonstrated improved hydration habits, decreased caffeine and alcohol intake, and healthier responses to symptoms of throat irritation or vocal fatigue (Pomaville et al., 2019). Significantly better ($p < .05$) EASE scores ($n = 1,4\%$) and a statistically significant ($p < .05$) increase in awareness of vocal hygiene ($n = 1, 4\%$) three months after the application of a vocal hygiene awareness program were observed (Bolbol et al., 2017; Zuim et al., 2019). One study (4%) found PVUs educated in VH ($n = 1, 4\%$) also showed significantly improved VHI scores (from 14.2 to 6.8), whereas those who were not showed a significant worsening (from 10.1 to 13.7) (Faham et al., 2016). These effects were significant ($p < .05$) for the total VHI score and all subscales (Faham et al., 2016). Another study ($n = 1,4\%$) comparing VHE alone to VHE in combination with direct voice therapy demonstrated that a VHE program prevented the worsening of VHI scores occurring in all control participants over 4–8 weeks (Nanjundeswaran et al., 2012). It was found that a VHE program may be sufficient in preventing voice problems in healthy PVUs. However, for PVUs with existing voice problems, voice therapy may be required to optimize results (Nanjundeswaran et al., 2012). It is important to note that future PVUs often report ($n = 1, 4\%$) a moderate degree of vocal handicap although they simultaneously report inconsistent implementation of VH practices (Achey et al., 2016).

Studies only using acoustic analysis

One study (4%) found that PVUs can enhance their vocal and prosodic features, and therefore their expressiveness when maintaining optimal vocal hygiene practices

(Rodero et al., 2018). After a 30-hour educational course on professional voice care, vocal hygiene, auditory perception, relaxation, postural control, voice production, voice properties, and prosody significant differences ($p < .05$) were observed in voice features such as breathing, articulation, loudness (dB), pitch, jitter, speech rate, pauses, and stress (Rodero et al., 2018).

Studies that used a combination of outcome measures

One study ($n = 1, 4\%$) found that the voice range profile (VRP) of PVUs positively changed as a result of vocal training and VHE learnt throughout a three-year bachelor's singing curriculum, yet it is important to note that PVUs' self-evaluations ($n = 1, 4\%$) of their voice changes appear to contradict VRP findings at times (Pabon et al., 2014). It was found that a VHE training program ($n = 1, 4\%$) improved the voice quality of PVUs, compared to those who were not, in whom a reduction in voice quality could be observed (Richter et al., 2016). PVUs trained in VHE ($n = 1, 4\%$) were able to better sustain their voice quality across a vocal loading task, increased in DSI score over three surveys, and significantly improved ($p < .05$) their awareness of voice use and mental health compared to those who were not trained in VHE (Nusseck et al., 2019). The positive effects of VHE training were maintained for 2 years after completion of training (Nusseck et al., 2019). Another study ($n = 1, 4\%$) similarly observed PVUs trained in VH outperform PVUs who had not received training with a significant increase in knowledge on vocal hygiene ($p < .05$) and the vocal mechanism ($p < .05$) when questioned (Sezin et al., 2020). In one study ($n = 1, 4\%$), PVUs who had been trained in VHE demonstrated significantly ($p < .05$) improved audio-perceptual values and their vocal quality remained unaffected over time compared to the untrained PVUs, whose vocal qualities deteriorated (Sezin et al., 2020). Two studies (8,6%) have, however, shown that VHE is more effective when combined with direct voice therapy (Liu et al., 2020; Rodríguez-Parra et al., 2011). When VHE is presented in isolation, the superiority of a voice therapy (direct treatment) approach is seen over a vocal hygiene program (indirect treatment) (Rodríguez-Parra et al., 2011). PVUs receiving only VHE ($n = 1, 4\%$) did not show significant improvement in their voice quality (Liu et al., 2020). The direct treatment approach ($n = 1, 4\%$) is shown to have more positive effects than vocal hygiene-based therapy alone in 4 to 5 of 8

continuous measures of voice (Maximum phonation time, Maximum exhalation time, Maximum phonation time during connected speech, Jitter, Well-being, Self-voice, Hygiene, and Anxiety) in PVUs with dysphonic voices (Rodríguez-Parra et al., 2011). A combination of vocal training, VHE, and breathing exercises (n = 1, 4%) also proved to be an effective method in the prevention of voice disorders in PVUs with dysphonia (Jałowska et al., 2017). Though VHE facilitates improvement in awareness and knowledge of phono-traumatic behaviors and vocal health, the use of VHE in isolation was limited in producing improvements based on the Dysphonia Severity Index (DSI) scores and laryngeal videostroboscopic examination (Nallamuthu et al., 2021). Stage performance occupations are easily impacted by undesirable changes in the quality of voice and airflow for voice production (Rangarathnam et al., 2018). Knowledge and practice of vocal hygiene have shown to have some impact on these changes; however, it was concluded that vocal hygiene alone may not be the best prevention measure to safeguard performers against these changes (Rangarathnam et al., 2018).

1.5 Discussion

Critical appraisal of recent peer-reviewed, scientific evidence on the effect of vocal hygiene education on professional voice users' voice quality showed the following. Most of the studies (n = 13; 68%) were conducted in HICs, indicating that the majority of research on VHE and vocal quality is centralized in HICs. This may not only result in the insufficient spread of access to evidence supporting practice but also a disparity in the participant population groups shaping the findings presented. Although many studies (n = 10; 43%) reviewed were survey-based studies using a cross-sectional design known to provide a lower level of evidence, the majority of studies provided strong levels of evidence (n = 13; 56%) as they made use of cohort studies (n = 6; 26%) randomized control trial studies (n = 6; 26%) and a within-subject study (n = 1; 4%) for the research design. Most of the studies reviewed (n = 11, 58%) also scored a high evidence level rating of IIb according to ASHA's levels of evidence (American Speech-Language-Hearing Association, 2004), which points to the high credibility of the evidence gathered. Assessment of the risk of bias confirmed an overall fair quality of evidence observed across all studies included.

From the results reviewed on VHE and vocal quality, the following can be gathered and emphasized. The positive effects of VHE training in PVUs are increased awareness of vocal hygiene and knowledge of the vocal mechanism^{4,22,23}, better-sustained voice quality across a vocal loading task improved DSI scores, and better mental health (Nusseck et al., 2019), increased perceptual voice quality values as well as enhancement of associated vocal and prosodic features (such as breathing, articulation, loudness, pitch, jitter, speech rate, pauses, and stress) (Rodero et al., 2018). Some studies observed the lasting effects of VHE maintained in PVUs after training had ceased, emphasizing the importance of VHE as a long-term investment for voice-related healthy working life (Nusseck et al., 2019). The research reviewed suggests that increasing awareness about occupational vocal hygiene will help to improve PVUs' voice-related quality of work and to minimize any permanent vocal disability and/or impairments (Bolbol et al., 2017).

Many studies highlighted the need for regular vocal training and VHE in PVUs as well as the negative effects on vocal outcomes when lacking. This lack of VHE is directly linked to the prevalence of self-reported acute and chronic voice symptoms and a greater perception of voice handicap among PVUs (Aiken & Rumbach, 2018; Coelho et al., 2020; Cruz et al., 2019; Neto & Meyer, 2017). Yet it is important to note that PVUs who have been exposed to VHE still report poor self-evaluations of their voices in contradiction to acoustic findings and admit inconsistent implementation of VH practices (Achey et al., 2016; Pabon et al., 2014). The reviewed studies found that a combination of direct voice treatment and VHE should be used for optimal outcomes as PVUs and future PVUs with and without voice disorders have elevated risk for dysphonia and voice disorders that are not effectively addressed through common vocal hygiene recommendations alone (Achey et al., 2016; Liu et al., 2020; Nallamuthu et al., 2021; Rangarathnam et al., 2018; Rodríguez-Parra et al., 2011). Limitations of the current systematic review include possible language bias as only articles written in English or translated to English were included leading to the possible omission of some studies. Although the VHE programmes utilized in the studies selected are based on the same principles, the programmes varied which may have affected the study outcomes.

1.6 Conclusion

Recent peer-reviewed, scientific literature demonstrates mixed results, obtained through auditory-perception, acoustic analysis, and self-rating scales, on the effect of VHE on vocal quality in PVUs. Yet, the positive outcomes presented are compelling enough to warrant implementing VHE programs for PVUs in combination with various direct voice training or therapy. Future research should aim to identify optimal combinations of direct and indirect (VHE) treatment approaches for PVUs and the unique challenges they face regarding occupational voice demands. VHE should be viewed as not only part of the treatment approach when an existing voice disorder is identified but also as a prevention tool implemented by the PVU in daily life. A future meta-analysis on the effect of VHE on various voice parameters should be explored. Future research from LMICs is essential as divergent contextual factors will influence vocal treatment approaches and therapy outcomes.

Data Availability Statement

Data will be stored electronically for 15 years in a code-protected room (room 3-19) within the Communication Pathology building, University of Pretoria (UP) as well as in the UP-data repository. All data will thus be stored on a password- and user-protected UP drive.

1.7 References

- Achey, M. A., He, M. Z., & Akst, L. M. (2016). Vocal Hygiene Habits and Vocal Handicap among Conservatory Students of Classical Singing. *Journal of Voice*, 30(2), 192–197. <https://doi.org/10.1016/j.jvoice.2015.02.003>
- Aiken, P. J., & Rumbach, A. F. (2018). Keeping the Voice Fit in the Group Fitness Industry: A Qualitative Study to Determine What Instructors Want in a Voice Education Program. *Journal of Voice*, 32(2), 256.e25-256.e34. <https://doi.org/10.1016/j.jvoice.2017.04.014>

- American Speech-Language-Hearing Association. (2004). *Evidence-Based Practice in Communication Disorders: An Introduction*. <https://doi.org/10.1044/policy.TR2004-00001>
- Barnes-Burroughs, K., & Rodriguez, M. C. (2012). The teaching performer: A survey of assets versus choices in voice use. *Journal of Voice*, 26(5), 642–655. <https://doi.org/10.1016/j.jvoice.2011.10.005>
- Barrett, E. A., Lam, W., & Yiu, E. M. L. (2020). Elicitation of Minimum and Maximum Fundamental Frequency and Vocal Intensity: Discrete Half Steps Versus Glissando. *Journal of Voice*, 34(2), 179–196. <https://doi.org/10.1016/j.jvoice.2018.09.023>
- Behlau, M., & Oliveira, G. (2009). Vocal hygiene for the voice professional. In *Current Opinion in Otolaryngology and Head and Neck Surgery* (Vol. 17, Issue 3, pp. 149–154). <https://doi.org/10.1097/MOO.0b013e32832af105>
- Behrman, A., & Sulica, L. (2003). Voice Rest after Microlaryngoscopy: Current Opinion and Practice. *Laryngoscope*, 113(12), 2182–2186. <https://doi.org/10.1097/00005537-200312000-00026>
- Bele, I. V. (2005). Reliability in perceptual analysis of voice quality. *Journal of Voice*, 19(4), 555–573. <https://doi.org/10.1016/j.jvoice.2004.08.008>
- Bolbol, S. A., Zalat, M. M., Hammam, R. A. M., & Elnakeb, N. L. (2017). Risk Factors of Voice Disorders and Impact of Vocal Hygiene Awareness Program Among Teachers in Public Schools in Egypt. *Journal of Voice*, 31(2), 251.e9-251.e16. <https://doi.org/10.1016/j.jvoice.2016.07.010>
- Boltežar, L., & Šereg Bahar, M. (2014). Voice Disorders in Occupations with Vocal Load in Slovenia. *Slovenian Journal of Public Health*, 53(4), 304–310. <https://doi.org/10.2478/sjph-2014-0033>
- Bottalico, P., & Astolfi, A. (2012). Investigations into vocal doses and parameters pertaining to primary school teachers in classrooms. *The Journal of the Acoustical Society of America*, 131(4), 2817–2827. <https://doi.org/10.1121/1.3689549>
- Braun-Janzen, C., & Zeine, L. (2009). Singers' Interest and Knowledge Levels of Vocal Function and Dysfunction: Survey Findings. *Journal of Voice*, 23(4), 470–483. <https://doi.org/10.1016/j.jvoice.2008.01.001>
- Buckley, K. L., O'Halloran, P. D., & Oates, J. M. (2015). Occupational Vocal Health of Elite Sports Coaches: An Exploratory Pilot Study of Football Coaches. *Journal of Voice*, 29(4), 476–483. <https://doi.org/10.1016/j.jvoice.2014.09.017>

- Buyukatalay, Z. C., Gokmen, M. F., Yaldaram, S., & Dursun, G. (2019). Voice Disorders in Islamic Religious Officials : Is It Any Different Than Those of the Teachers , Another Well-Known Professional Voice Users ? *Journal of Voice*, 34(5), 738–742. <https://doi.org/10.1016/j.jvoice.2019.02.001>
- Cantarella, G., Iofrida, E., Boria, P., Giordano, S., Binatti, O., Pignataro, L., Manfredi, C., Forti, S., & Dejonckere, P. (2014). Ambulatory phonation monitoring in a sample of 92 call center operators. *Journal of Voice*, 28(3), 393.e1-393.e6. <https://doi.org/10.1016/j.jvoice.2013.10.002>
- Cazden, J. (2017). Screaming for Attention: The Vocal Demands of Actors in Violent Interactive Games. In *Journal of Voice* (Vol. 31, Issue 1, pp. 1–2). Mosby Inc. <https://doi.org/10.1016/j.jvoice.2016.02.001>
- Christmann, M. K., Scherer, T. M., Cielo, C. A., & Hoffman, C. F. (2013). Maximum phonation time of future professional voice uers. *Revista CEFAC*, 15(3), 622–630.
- Coelho, J. dos S., Moreti, F., Pacheco, C., & Behlau, M. (2020). Self-perception of voice symptoms and vocal health and hygiene knowledge in popular and classical singers. *Codas*, 32(3), 1–6. <https://doi.org/10.1590/2317-1782/20202018304>
- Côrtes Gama, A. C., Camargo, Z., Rocha Santos, M. A., & Carlos Rusilo, L. (2015). Discriminant capacity of acoustic, perceptual, and vocal self: The effects of vocal demands. *Journal of Voice*, 29(2), 260.e45-260.e50. <https://doi.org/10.1016/j.jvoice.2014.06.012>
- Cruz, M. R. dos S. A., Yamasaki, R., Pacheco, C., Borrego, M. C. de M., & Behlau, M. (2019). Drama students with and without vocal complaint: Vocal health and hygiene data, symptoms and voice handicap. *Codas*, 31(5), 1–7. <https://doi.org/10.1590/2317-1782/20192018319>
- D'haeseleer, E., Claeys, S., Meerschman, I., Bettens, K., Degeest, S., Dijckmans, C., De Smet, J., Luyten, A., & Van Lierde, K. (2017). Vocal Characteristics and Laryngoscopic Findings in Future Musical Theater Performers. *Journal of Voice*, 31(4), 462–469. <https://doi.org/10.1016/j.jvoice.2016.11.018>
- Devadas, U., Hegde, M., & Maruthy, S. (2019). Prevalence and Risk Factors of Self-reported Voice Problems Among Yakshagana Artists. *Journal of Voice*, 33(1), 124.e35-124.e47. <https://doi.org/10.1016/j.jvoice.2017.09.010>
- Devadas, U., Jose, N., & Gunjawate, D. (2016). Prevalence and Influencing Risk Factors of Voice Problems in Priests in Kerala. *Journal of Voice*, 30(6), 771.e27-771.e32. <https://doi.org/10.1016/j.jvoice.2015.11.008>

- Erickson, M. L. (2012). The traditional/acoustic music project: A study of vocal demands and vocal health. *Journal of Voice*, 26(5), 664.e7-664.e23.
<https://doi.org/10.1016/j.jvoice.2011.09.002>
- Evidence Partners. (n.d.). *DistillerSR*.
- Faham, M., Ahmadi, A., Drinnan, M., Saadatmand, N., Fatahi, E., & Jalalipour, M. (2016). The Effects of a Voice Education Program on VHI Scores of Elementary School Teachers. *Journal of Voice*, 30(6), 755.e1-755.e11.
<https://doi.org/10.1016/j.jvoice.2015.09.009>
- Faham, M., Jalilevand, N., Torabinezhad, F., Silverman, E. P., Ahmadi, A., Anaraki, Z. G., & Jafari, N. (2017). Relationship between Voice Complaints and Subjective and Objective Measures of Vocal Function in Iranian Female Teachers. *Journal of Voice*, 31(4), 507.e1-507.e6. <https://doi.org/10.1016/j.jvoice.2016.10.011>
- Fairbanks, G. (1960). *Voice and articulation drillbook, 2nd edn.* (2nd ed.). Harper & Row.
- Franca, M. C. (2013). A comparison of vocal demands with vocal performance among classroom student teachers. *Journal of Communication Disorders*, 46(1), 111–123.
<https://doi.org/10.1016/j.jcomdis.2012.11.001>
- Franca, M. C., & Wagner, J. F. (2015). Effects of vocal demands on voice performance of student singers. *Journal of Voice*, 29(3), 324–332.
<https://doi.org/10.1016/j.jvoice.2014.07.004>
- Franco, R. A., & Andrus, J. G. (2007). Common Diagnoses and Treatments in Professional Voice Users. In *Otolaryngologic Clinics of North America* (Vol. 40, Issue 5, pp. 1025–1061). <https://doi.org/10.1016/j.otc.2007.05.008>
- Fuentes-López, E., Fuente, A., & Contreras, K. V. (2019). Inadequate vocal hygiene habits associated with the presence of self-reported voice symptoms in telemarketers. *Logopedics Phoniatrics Vocology*, 44(3), 105–114.
<https://doi.org/10.1080/14015439.2017.1414302>
- Garzón García, M., Muñoz López, J., & y Mendoza Lara, E. (2017). Voice Habits and Behaviors: Voice Care Among Flamenco Singers. *Journal of Voice*, 31(2), 246.e11-246.e19. <https://doi.org/10.1016/j.jvoice.2016.08.007>
- Gaskill, C., & Hetzel, A. (2017). Managing “Vocal Dose” and the acting voice: how much is too much? *Voice and Speech Review*, 11(3), 262–278.
<https://doi.org/10.1080/23268263.2017.1389811>

- Goy, H., Fernandes, D. N., Pichora-fuller, M. K., & Lieshout, P. Van. (2013). Normative Voice Data for Younger and Older Adults. *Journal of Voice*, 27(5), 545–555.
<https://doi.org/10.1016/j.jvoice.2013.03.002>
- Gunasekaran, N., Boominathan, P., & Seethapathy, J. (2016). Voice Needs and Voice Demands of Professional Newsreaders in Southern India. *Journal of Voice*, 30(6), 756.e9-756.e20. <https://doi.org/10.1016/j.jvoice.2015.09.001>
- Haben, C. M. (2012). Voice rest and phonotrauma in singers. *Medical Problems of Performing Artists*, 27(3), 165–168. <https://doi.org/10.21091/mppa.2012.3029>
- Hackworth, R. S. (2006). Preservice Music Teachers' Perceptions of Vocal Hygiene: Findings from a National Survey. *Journal of Music Teacher Education*, 16(1), 20–31.
<https://doi.org/10.1177/10570837060160010104>
- Hakkesteegt, M. M., Brocaar, M. P., & Wieringa, M. H. (2010). The Applicability of the Dysphonia Severity Index and the Voice Handicap Index in Evaluating Effects of Voice Therapy and Phonosurgery. *Journal of Voice*, 24(2), 199–205.
<https://doi.org/10.1016/j.jvoice.2008.06.007>
- Hapner, E., & Gilman, M. (2012). The vocal load of Reform Jewish Cantors in the USA. *Journal of Voice*, 26(2), 201–204. <https://doi.org/10.1016/j.jvoice.2011.01.003>
- Hazlett, D., Duffy, O., & Moorhead, S. (2009). Occupational voice demands and their impact on the call-centre industry. *BMC Public Health*, 9.
<https://doi.org/10.1186/1471-2458-9-108>
- Higgins, J. P., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., Savović, J., Schulz, K. F., Weeks, L., & Sterne, J. A. (2011). The Cochrane Public Health Group Guide for developing a Cochrane protocol. *BMJ (Online)*, 343(November).
- Hoffman-ruddy, B., Lehman, J., Crandell, C., Ingram, D., Sapienza, C., & Al, B. H. E. T. (2001). Laryngostroboscopic , Acoustic , and Environmental Characteristics of High-Risk Vocal Performers. *Journal of Voice*, 15(4), 543–552.
- Jałowska, M., Wośkowiak, G., & Wiskirska-Woźnica, B. (2017). Ocena wyników programu profilaktycznego „chroń swój głos” przeprowadzonego przez wielkopolskie centrum medycyny pracy w Poznaniu. *Medycyna Pracy*, 68(5), 575–581. <https://doi.org/10.13075/mp.5893.00545>
- Kaneko, M., Shiromoto, O., Fujiu-Kurachi, M., Kishimoto, Y., Tateya, I., & Hirano, S. (2017). Optimal Duration for Voice Rest After Vocal Fold Surgery: Randomized

- Controlled Clinical Study. *Journal of Voice*, 31(1), 97–103.
<https://doi.org/10.1016/j.jvoice.2016.02.009>
- Koufman, J. A., Amin, M. R., & Panetti, M. (2000). Prevalence of reflux in 113 consecutive patients with laryngeal and voice disorders. *Otolaryngology - Head and Neck Surgery*, 123(4), 385–388. <https://doi.org/10.1067/mhn.2000.109935>
- Koufman, J. A., & Isaacson, G. (1991). The spectrum of vocal dysfunction. *Otolaryngol Clin North Am*, 5(Oct;24), 985–988.
- Latham, K., Messing, B., Bidlack, M., Merritt, S., Zhou, X., & Akst, L. M. (2017). Vocal Health Education and Medical Resources for Graduate-Level Vocal Performance Students. *Journal of Voice*, 31(2), 251.e1-251.e7.
<https://doi.org/10.1016/j.jvoice.2016.07.011>
- Leedy, P. D., & Ormrod, J. E. (2021). Practical Research: Planning and Design, Global Edition. In *Pearson* (12th ed., Vol. 12). Pearson Education Limited.
- Lehto, L., Laaksonen, L., Vilkinen, E., & Alku, P. (2008). Changes in Objective Acoustic Measurements and Subjective Voice Complaints in Call Center Customer-Service Advisors During One Working Day. *Journal of Voice*, 22(2), 164–177.
<https://doi.org/10.1016/j.jvoice.2006.08.010>
- Lierde, K. M. Van, Evelien, D., Wuyts, F. L., & Ley, S. De. (2010). The Objective Vocal Quality , Vocal Risk Factors , Vocal Complaints , and Corporal Pain in Dutch Female Students Training to be Speech-Language Pathologists During the 4 Years of Study. *Journal of Voice*, 24(5), 592–598. <https://doi.org/10.1016/j.jvoice.2008.12.011>
- Liu, H., Chen, S. H., Gao, L., Li, J., Liu, B., Raj, H., Xie, Q., Duan, H., Jiang, Z., Liu, Y., Chen, B., Liu, Y., & Jiang, J. (2020). Comparison Between Combination of Resonant Voice Therapy and Vocal Hygiene Education and Vocal Hygiene Education Only for Female Elementary School Teachers. *Journal of Voice*.
<https://doi.org/10.1016/j.jvoice.2020.09.028>
- Moher, D., Shamseer, L., Clarke, M., Gherzi, D., Liberati, A., Petticrew, M., Shekelle, P., & Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews*, 4(1), 1.
<https://doi.org/10.1186/2046-4053-4-1>
- Morrow, S. L., & Connor, N. P. (2011). Voice amplification as a means of reducing vocal load for elementary music teachers. *Journal of Voice*, 25(4), 441–446.
<https://doi.org/10.1016/j.jvoice.2010.04.003>

- Munier, C., & Farrell, R. (2016). Working Conditions and Workplace Barriers to Vocal Health in Primary School Teachers. *Journal of Voice*, 30(1), 127.e31-127.e41. <https://doi.org/10.1016/j.jvoice.2015.03.004>
- Nallamuthu, A., Boominathan, P., Arunachalam, R., & Mariswamy, P. (2021). Outcomes of Vocal Hygiene Program in Facilitating Vocal Health in Female School Teachers With Voice Problems. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2020.12.041>
- Nanjundeswaran, C., Jacobson, B. H., & Gartner-Schmidt, J. (2015). Vocal Fatigue Index (VFI): Development and Validation. *Journal of Voice*, 29(4), 433–440. <https://doi.org/10.1016/j.jvoice.2014.09.012>
- Nanjundeswaran, C., Li, N. Y. K., Chan, K. M. K., Wong, R. K. S., Yiu, E. M. L., & Verdolini-Abbott, K. (2012). Preliminary data on prevention and treatment of voice problems in student teachers. *Journal of Voice*, 26(6), 816.e1-816.e12. <https://doi.org/10.1016/j.jvoice.2012.04.008>
- Nemr, K., Simões-Zenari, M., Cologis, V. C. de A., Martins, G. A., Saito, I. T., & Gonçalves, R. da S. (2021). COVID-19 and Remote Learning: Predictive Factors of Perceived Improvement or Worsening of the Voice in Brazilian Teachers. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2021.08.010>
- Neto, L., & Meyer, D. (2017). A Joyful Noise: The Vocal Health of Worship Leaders and Contemporary Christian Singers. *Journal of Voice*, 31(2), 250.e17-250.e21. <https://doi.org/10.1016/j.jvoice.2016.07.012>
- Nusseck, M., Immerz, A., Spahn, C., Echternach, M., & Richter, B. (2019). Long-Term Effects of a Voice Training Program for Teachers on Vocal and Mental Health. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2019.11.016>
- Nusseck, M., Spahn, C., Echternach, M., Immerz, A., & Richter, B. (2018). Vocal Health, Voice Self-concept and Quality of Life in German School Teachers. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2018.11.008>
- Pabon, P., Stallinga, R., Södersten, M., & Ternström, S. (2014). Effects on vocal range and voice quality of singing voice training: The classically trained female voice. *Journal of Voice*, 28(1), 36–51. <https://doi.org/10.1016/j.jvoice.2013.06.005>
- Pacheco, C., & Behlau, M. (2019). Immediate Impact of Vocal Demand on Musical Theater Singers in Brazil. *Journal of Voice*, 33(5), 804.e13-804.e22. <https://doi.org/10.1016/j.jvoice.2018.04.013>
- Piowarczyk, T. C., Oliveira, G., Loureno, L., & Behlau, M. (2012). Vocal symptoms, voice activity, and participation profile and professional performance of call center

- operators. In *Journal of Voice* (Vol. 26, Issue 2, pp. 194–200). Mosby Inc.
<https://doi.org/10.1016/j.jvoice.2011.02.006>
- Pole, C., & Hillyard, S. (2016). *Doing Fieldwork*. SAGE Publications Inc.
<https://doi.org/https://doi.org/10.4135/9781473966383>
- Pomaville, F., Tekerlek, K., & Radford, A. (2019). The Effectiveness of Vocal Hygiene Education for Decreasing At-Risk Vocal Behaviors in Vocal Performers. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2019.03.004>
- Porcaro, C. K., Howery, S., Suhandron, A., & Gollery, T. (2019). Impact of Vocal Hygiene Training on Teachers' Willingness to Change Vocal Behaviors. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2019.11.011>
- Primov-Fever, A., Roziner, I., & Amir, O. (2020). Songbirds Must Sing: How Artistic Voice Users Perceive Their Voice in Times of COVID-19. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2020.07.030>
- Rangarathnam, B., Paramby, T., & McCullough, G. H. (2018). "Prologues to a Bad Voice": Effect of Vocal Hygiene Knowledge and Training on Voice Quality Following Stage Performance. *Journal of Voice*, 32(3), 300–306.
<https://doi.org/10.1016/j.jvoice.2017.05.026>
- Reed, J. P., & Sims, H. S. (2017). Comparative Analysis of Characteristics of Voice Use Amidst Clergy. *Journal of Voice*, 31(2), 256.e7-256.e11.
<https://doi.org/10.1016/j.jvoice.2016.06.005>
- Regional eXplorer, 1029 (2.5w). (2015). *IHS Global Insight, Regional eXplorer 1029 (2.5w), 2015*. IHS Global Insight.
- Ribeiro, V. V., Dassie-Leite, A. P., Pereira, E. C., Santos, A. D. N., Martins, P., & Irineu, R. de A. (2020). Effect of Wearing a Face Mask on Vocal Self-Perception during a Pandemic. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2020.09.006>
- Richter, B., Nusseck, M., Spahn, C., & Echternach, M. (2016). Effectiveness of a Voice Training Program for Student Teachers on Vocal Health. *Journal of Voice*, 30(4), 452–459. <https://doi.org/10.1016/j.jvoice.2015.05.005>
- Rodero, E., Diaz-Rodriguez, C., & Larrea, O. (2018). A Training Model for Improving Journalists' Voice. *Journal of Voice*, 32(3), 386.e11-386.e19.
<https://doi.org/10.1016/j.jvoice.2017.05.006>
- Rodríguez-Parra, M. J., Adrián, J. A., & Casado, J. C. (2011). Comparing voice-therapy and vocal-hygiene treatments in dysphonia using a limited multidimensional

- evaluation protocol. *Journal of Communication Disorders*, 44(6), 615–630.
<https://doi.org/10.1016/j.jcomdis.2011.07.003>
- Rosen, C. A., Lee, A. S., Osborne, J., Zullo, T., & Murry, T. (2004). Development and Validation of the Voice Handicap Index-10. *Laryngoscope*, 114(9), 1549–1556.
<https://doi-org.uplib.idm.oclc.org/10.1097/00005537-200409000-00009>
- Rumbach, A. F. (2013). Vocal problems of group fitness instructors: Prevalence of self-reported sensory and auditory-perceptual voice symptoms and the need for preventative education and training. *Journal of Voice*, 27(4), 524.e11-524.e21.
<https://doi.org/10.1016/j.jvoice.2013.01.016>
- Schloneger, M. J. (2011). Graduate student voice use and vocal efficiency in an opera rehearsal week: A case study. *Journal of Voice*, 25(6), e265–e273.
<https://doi.org/10.1016/j.jvoice.2010.09.010>
- Sezin, R. K., Özcebe, E., Aydinli, F. E., Köse, A., & Günaydin, R. Ö. (2020). Investigation of the Effectiveness of a Holistic Vocal Training Program Designed to Preserve Theatre Students' Vocal Health and Increase Their Vocal Performances; A Prospective Research Study. *Journal of Voice*, 34(2), 302.e21-302.e28.
<https://doi.org/10.1016/j.jvoice.2018.08.009>
- Shamseer, L., Moher, D., Clarke, M., Gherzi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L. A., Altman, D. G., Booth, A., Chan, A. W., Chang, S., Clifford, T., Dickersin, K., Egger, M., Gøtzsche, P. C., Grimshaw, J. M., Groves, T., Helfand, M., Whitlock, E. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: Elaboration and explanation. *BMJ (Online)*, 349(January), 1–25. <https://doi.org/10.1136/bmj.g7647>
- Siqueira, L. T. D., Santos, A. P. dos, Silva, R. L. F., Moreira, P. A. M., Vitor, J. da S., & Ribeiro, V. V. (2020). Vocal Self-Perception of Home Office Workers During the COVID-19 Pandemic. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2020.10.016>
- Solomon, N. P. (2008). Vocal fatigue and its relation to vocal hyperfunction. *International Journal of Speech-Language Pathology*, 10(4), 254–266.
<https://doi.org/10.1080/14417040701730990>
- Thomas, G., Kooijman, P. G. C., Donders, A. R. T., Cremers, C. W. R. J., & de Jong, F. I. C. R. S. (2007). The Voice Handicap of Student-Teachers and Risk Factors Perceived to Have a Negative Influence on the Voice. *Journal of Voice*, 21(3), 325–336. <https://doi.org/10.1016/j.jvoice.2005.12.003>

- Timmermans, B., De Bodt, M., Wuyts, F., & Van de Heyning, P. (2004). Voice quality change in future professional voice users after 9 months of voice training. *European Archives of Oto-Rhino-Laryngology*, 261(1), 1–5. <https://doi.org/10.1007/s00405-003-0652-5>
- Timmermans, B., Vanderwegen, J., & De Bodt, M. S. (2005). Outcome of vocal hygiene in singers. In *Curr Opin Otolaryngol Head Neck Surg* (Vol. 13).
- Titze, I. R. (1994). *Principles of voice production* (Illustrate). Prentice Hall, 1994.
- Van Der Merwe, A. (2004). The voice use reduction program. *American Journal of Speech-Language Pathology*, 13(3), 208–218. [https://doi.org/10.1044/1058-0360\(2004/022\)](https://doi.org/10.1044/1058-0360(2004/022))
- Van Lierde, K. M., Bonte, K., Baudonck, N., Van Cauwenberge, P., & De Leenheer, E. M. R. (2008). Speech Outcome regarding Overall Intelligibility, Articulation, Resonance and Voice in Flemish Children a Year after Pharyngeal Flap Surgery. *Folia Phoniatica et Logopaedica*, 60(5), 223–232. <https://doi.org/10.1159/000151242>
- Van Overmeiren, T., Meerschman, I., D'haeseleer, E., & Van Lierde, K. (2018). The vocal symptoms and habits of professional voice users. *B-ENT*, 14, 271–280.
- Vasilakis, M., & Stylianou, Y. (2009). Voice pathology detection based on short-term jitter estimations in running speech. *Folia Phoniatica et Logopaedica*, 61(3), 153–170. <https://doi.org/10.1159/000219951>
- Wells, G., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M., & Tugwell, P. (2014). *The Newcastle-Ottawa Scale (NOS) for assessing quality of nonrandomised studies in meta-analyses. Update*. Ottawa Hospital Research Institute. http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
- Wingate, J. M., Brown, W. S., Shrivastav, R., Davenport, P., & Sapienza, C. M. (2007). Treatment Outcomes for Professional Voice Users. *Journal of Voice*, 21(4), 433–449. <https://doi.org/10.1016/j.jvoice.2006.01.001>
- Wuyts, F. L., De Bodt, M. S., Molenberghs, G., Remacle, M., Heylen, L., Millet, B., Van Lierde, K., Raes, J., & Van De Heyning, P. H. (2000). The Dysphonia Severity Index: An Objective Measure of Vocal Quality Based on a Multiparameter Approach. *Journal of Speech, Language, and Hearing Research*, 43(3), 796–809. <https://doi.org/10.1044/jslhr.4303.796>
- Yamauchi, E. J., Imaizumi, S., Maruyama, H., & Haji, T. (2010). Perceptual evaluation of pathological voice quality: a comparative analysis between the RASATI and GRBASI

scales. *Logopedics, Phoniatrics, Vocology*, 35(3), 121–128.

<https://doi.org/10.3109/14015430903334269>

Yu, P., Ouaknine, M., Revis, J., & Giovanni, A. (2001). *Objective Voice Analysis for Dysphonic Patients : A Multiparametric Protocol Including Acoustic and Aerodynamic Measurements*. 15(4), 529–542.

Zuim, A. F., Lloyd, A. T., Gerhard, J., Rosow, D., & Lundy, D. (2019). Associations of Education and Training with Perceived Singing Voice Function Among Professional Singers. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2019.10.003>

Table 1.2: Study characteristics and main findings

Study Title	Author & Date published	Country	Participant voice characteristics	ASHAs Level of evidence	Profession of participants in study (PVU)	Study Design	Outcome measures used	Main findings
<i>High-income countries</i>								
A joyful noise: the vocal health of worship leaders and contemporary Christian singers (Neto & Meyer, 2017)	Neto L. & Meyer D. (2017)	USA	Normal	III	Contemporary Christian Singers & Worship Leaders	Cross-sectional	Questionnaire (self-rating)	Acute vocal symptoms were linked to low awareness of VH principles.
Vocal problems of group fitness instructors: prevalence of self-reported sensory and auditory-perceptual voice symptoms and the need for preventative education and training (Rumbach, 2013)	Rumbach A. F. (2013)	Australia	Normal	III	Group fitness instructors	Cross-sectional	Questionnaire (self-rating)	Acute and chronic vocal symptoms were linked to lack of VHE and voice training.
Vocal hygiene habits and vocal handicap among conservatory students of classical singing (Achey et al., 2016)	Achey M. A., He M.Z. & Akst L. M. (2016)	USA	Normal	III	Classical singing students	Cross sectional	Singing Voice Handicap Index 10 (SVHI-10)	Due to the inconsistent implementation of VH practices, students may have elevated risk for dysphonia and voice disorders that is not effectively addressed through common vocal hygiene

								recommendations alone.
Associations of education and training with perceived singing voice function among professional singers (Zuim et al., 2019)	Zuim A. F., Lloyd A. T., Gerhard J., Rosow D. & Lundy D. (2019)	USA	Normal	III	Professional singers	Cross sectional	Questionnaire & Evaluation of the Ability to Sing Easily (EASE)	Significantly lower (better) EASE scores (P-values <0.05) were linked to those participants who received VHE.
Inadequate vocal hygiene habits associated with the presence of self-reported voice symptoms in telemarketers (Fuentes-López et al., 2019)	Fuentes-Lopez E., Fuentec A. & Contreras K. V. (2017)	Chile	Normal	III	Telemarketers	Cross sectional	Vocal hygiene habits, and vocal symptoms Questionnaire	The frequency of unfavourable vocal hygiene habits was correlated to the number of vocal symptoms reported.
The effects of a voice education program on VHI scores of elementary school teachers (Faham et al., 2016)	Faham M., Ahmadi A., Drinnan M., Saadatmand N., Fatahi E. & Jalalipour M. (2016)	USA	Normal	Ib	Teachers	Randomized control trial	VHI	A VH education program can have positive effects on the voice of teachers, even without dysphonia.
A training model for improving journalists' voice (Rodero et al., 2018)	Rodero E., Diaz-Rodriguez C. & Larrea O. (2018)	Spain	Normal	Ib	Student journalists	Randomized control trial	Acoustic analysis	Participants were thus able to enhance their main vocal and prosodic

								elements, and therefore their expressiveness when maintaining optimal vocal hygiene practices.
Evaluation of the results of the prevention program “protect your voice” implemented by the greater Poland centre of occupational medicine of Poznan (Jałowska et al., 2017)	Jałowska M., Woškowiak G., Wiskirska-Woźnica B. (2017)	Poland	Dysphonic	Ib	Teachers with occupational voice disorders	Randomized control trial	Phoniatric examination, videostroboscopy, Questionnaire (self-rating)	A combination of vocal training, VHE and breathing exercises prove to be an effective method in the prevention of voice disorders in teachers.
Impact of Vocal Hygiene Training on Teachers’ Willingness to Change Vocal Behaviors (Porcaro et al., 2019)	Porcaro C.K., Howery S., Suhandron A., & Gollery T. (2019)	USA	Normal	III	Teachers	Cross-sectional	Questionnaire (self-rating)	The effect of vocal hygiene training on teachers’ willingness to implement vocally hygienic behaviours was statistically significant ($d \geq 0.80$). An Increase in perceived desire to engage in vocal

								hygiene behaviours was seen in nearly 90% of the targeted vocal hygiene behaviours. Teachers benefit from receiving VHE and show willingness to incorporate these techniques into their daily lives.
Preliminary Data on Prevention and Treatment of Voice Problems in Student Teachers (Nanjundeswaran et al., 2012)	Nanjundeswaran C., Li N.Y.K, Chan K.M.K, Wong R.K.S., Yiu E.M.L , & Verdolini-Abbott K. (2012)	USA	Normal	Ib	Student Teachers	Randomized control trial	VHI	The VH program prevented worsening of VHI scores that occurred in all control participants over the 4–8 weeks of student teaching. A VH program may be sufficient to prevent voice problems in healthy student teachers. However, for student

								teachers with existing voice problems, voice therapy may be required to optimize results.
Vocal Health Education and Medical Resources for Graduate-Level Vocal Performance Students (Latham et al., 2016)	Latham K., Messing B, Bidlack M., Merritt S., Zhou X, & Akst L.M.(2016)	USA	Normal	III	Vocal Performance Students	Cross-sectional	Questionnaire (self-rating)	Singers strongly agree that vocal physiology and vocal health should be taught in graduate voice curriculum, and that knowledge of vocal health might help PVUs limit injuries. Overall, the amount and quality of the instruction provided in respective institutions was perceived positively. However, there are several perceived barriers to incorporating vocal health education into

								graduate singing programs such as; limited time in the curriculum, lack of financial support, and lack of availability of a medical professional.
The Effectiveness of Vocal Hygiene Education for Decreasing At-Risk Vocal Behaviors in Vocal Performers (Pomaville et al., 2019)	Pomaville F., Tekerlek K., & Radford A. (2019)/	USA	Normal	III	Vocal Performers	Single group pre-test post-test study	Questionnaire (self-rating)	Participation in a VHE program increases knowledge of voice production and vocal hygiene, can positively influence intake of water, caffeine, and alcohol, increase healthier responses to laryngeal irritation and symptoms of vocal fatigue, and may decrease negative symptoms

								associated with voice use.
Comparing voice-therapy and vocal-hygiene treatments in dysphonia using a limited multidimensional evaluation protocol (Rodríguez-Parra et al., 2011a)	Rodríguez-Parra M. J., Jose A. J. A., Casado J. C (2011)	Spain	Dysphonic	Ib	Mixed PVUs: -teachers -singers -television announcers -sales people -beauticians -administrators	Randomized control trial	Acoustic analysis, spectrographic evaluation, perceptual (GRBAS), laryngostroboscopic assessments & self-rating	Direct voice-therapy treatment is shown to have more positive effects than vocal hygiene-based therapy in 4 to 5 of the 8 continuous measures of voice disorder analysed.
“Prologues to a bad voice”: Effect of vocal hygiene knowledge and training on voice quality following stage performance (Rangarathnam et al., 2018)	Rangarathnam B., Paramby T., & McCullough G. H. (2018)	USA	Normal	III	Stage actors	Single group pre-test post-test study	Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) & Acoustic analysis.	Stage performances impact vocal outcomes with a reduction in quality and efficient use of airflow for voice production. Knowledge and practice of vocal hygiene have some impact on these changes; however vocal hygiene alone may not be the best “shield” to

								prevent these changes
Effects on vocal range and voice quality of singing voice training: The classically trained female voice (Pabon et al., 2014)	Pabon P., Stalling R., Sodersten M. & Ternstrom S. (2014)	Sweden	Normal	III	Classical singers	Single group pre-test post-test study	Voice range profile VPR & Questionnaire (self-rating)	VRP can positively change in shape, size, and quality pattern as a result of vocal training and VHE in classically trained singers although the students self-reporting did at times contradict the findings
Effectiveness of a voice training program for student teachers on vocal health (Richter et al., 2016)	Richter B., Nusseck M., Spahn C. & Echternach M. (2016)	Germany	Normal	Ila	Student teachers	Non-randomized controlled study	Dysphonia severity index (DSI) Vocal loading test (VLT) VHI	A VHE training program improved the voice quality of the trained group compared with that of the control group, whose voice quality declined. The trained group could also better sustain their voice

								quality across the VLT.
Long-term effects of a voice training program for teachers on vocal and mental health (Nusseck et al., 2019)	Nusseck M., Immerz A., Spahn C., Echternach M. & Richter B. (2019)	Germany	Normal	Ila	Teachers	Non-randomized controlled study	Acoustic analysis German VHI-12 Assessment of the voice self-concept (FESS)	Those trained in VHE increased in DSI over all three surveys while the nontrained teachers decreased in DSI with a significant interaction effect. The trained teachers also significantly increased the awareness of voice use and their mental health compared to the nontrained group
Upper and Lower-middle income countries								
Drama students with and without vocal complaint: vocal health and hygiene data, symptoms and voice handicap (Cruz et al., 2019)	Dos Santos M, R. , Amarante Cruz A., Yamasaki.R, Pacheco C., De Menezes Borrego M. C. & Behlau M. (2019)	Brazil	Group 1= Vocal complaints (WVC) Group 2= No vocal complaints (NCG)	III	Drama students	Cross sectional	Voice Symptom Scale (VoiSS); and Voice Handicap Index (VHI-10)	Increased voice symptoms and a greater perception of voice handicap were correlated with poor

								knowledge of vocal hygiene.
Self-perception of voice symptoms and vocal health and hygiene knowledge in popular and classical singers (Coelho et al., 2020)	Dos Santos Coelho J., Moreti F., Pacheco C. & Behlau M. (2019)	Brazil	Normal	III	-Popular singers -Classical singers	Cross sectional	The vocal self-assessment questionnaire for the singing voice, The Brazilian validated version of Voice Symptom Scale (VoiSS)	The perception of vocal variation between popular and classical singers seems to have no relation to the degree of vocal hygiene knowledge obtained.
Investigation of the effectiveness of a holistic vocal training program designed to preserve theatre students' vocal health and increase their vocal performances; A prospective research study (Sezin et al., 2020)	Sezin R. K., Ozcebe E., Aydinli F. E., Sen Kose A. & Gunaydin R. O. (2018)	Turkey	Normal	Ib	Conservatory theatre students	Randomized control trial	Acoustic Analysis CAPE-V	Acoustic findings revealed that the vocal qualities of the control group deteriorated, whereas no change was seen in the study group. Audio-perceptual values were significantly improved for the study group

Comparison between combination of resonant voice therapy and vocal hygiene education and vocal hygiene education only for female elementary school teachers (Liu et al., 2020)	Liu H., Chen S., Gao L., Li J., Liu B., Raj H., Xie Q., Duan H., Jiang Z., Liu Y., Chen B., Liu Y. & Jiang J. (2020)	China	Normal	Ib	Teachers	Randomized control trial	Acoustic analysis GRBAS VHI-10	A combination of vocal hygiene education and resonant voice therapy can significantly improve the voice function of PVUs and effectively improve their voice quality
Risk factors of voice disorders and impact of vocal hygiene awareness program among teachers in public schools in Egypt (Bolbol et al., 2017)	Bolbol S. A., Zalat M. M., Hammam R. A. M. & Elnakeb N. L. (2017)	Egypt	Normal	III	Teachers	Cross sectional	Questionnaire VHI laryngo-video-stroboscopy,	Increasing awareness about VH improves teachers' quality of work and helps minimize any permanent vocal disability and/or impairments.
Outcomes of vocal hygiene program in facilitating vocal health in female school teachers with voice problems(Nallamuthu et al., 2021)	Nallamuthu A., Boominathan P., Arunachalam R. & Mariswamy P. (2021)	India	Normal	III	Teachers	Single group pre-test post-test correlational study	GRBAS Acoustic analysis Stroboscopic exam V-DOP VFI	Though a Vocal Hygiene Program (VHP) facilitated improvement in teachers' awareness of phono-traumatic behaviours and

								vocal health, its efficiency was limited in producing physiological improvement in teachers' voices.
--	--	--	--	--	--	--	--	--

LEARNING OUTCOMES

As a result of this activity/article, the participant will be able to list the negative effects of a voice disorder seen in PVUs.

As a result of this activity/article, the participant will be able to explain which self-reported acute or chronic vocal symptom was most prevalent amongst PVUs.

As a result of this activity/article, the participant will be able to assess whether vocal hygiene programs should be used alone or in combination with direct voice therapy for optimal treatment outcomes.

CHAPTER 4

SELF-REPORTED VOCAL DEMANDS, PERCEPTIONS AND KNOWLEDGE OF OCCUPATIONAL VOICE USERS IN SOUTH AFRICA

Authors: Vermeulen, R., du Toit, M., van Lierde, K., Graham, A.M. & van der Linde, J

Journal: Journal of Voice

Impact factor: 2.3

Date accepted: 25 January 2023

Proof of acceptance: Appendix M

Publication: Published online ahead of print.

DOI: 10.1016/j.jvoice.2023.01.032

Note: This article was edited in accordance with the editorial specifications of the journal and may differ from the editorial style of the rest of this document.

1.1 Abstract

Objectives: The study aimed to describe daily vocal demands, perceptions and knowledge as reported by occupational voice users.

Study Design: A descriptive, cross-sectional research design was employed.

Methods: A survey on vocal demands, perceptions and knowledge was distributed to 102 occupational voice users via a snowball sampling technique.

Results: Slightly more than half of the participants (55%) reported using their voice for work 36,5 hours a week on average (SD= 15,5, range: 33-40). Participants reported that, on average, their daily voice use is 6,3 hours (SD= 2,7) for work and the majority (81%) reported a decrease in voice quality after work; Three-quarters (75%) also reported vocal fatigue at the end of the day. Approximately one-third (33%) reported being exposed to environments where they are expected to shout, scream or cheer loudly. More than half of the participants (61%) reported that they have previously received vocal health education but 40% reported that they felt this training was

insufficient. High vocal demands are significantly correlated to an increase in perceived vocal handicap $r_s=0,242$; ($p=0,018$), tiredness of voice $r_s=0,270$; ($p=0,008$), physical discomfort $r_s=0,217$; ($p=0,038$) as well as how occupational voice users experience improvement of symptoms with rest $r_s= -0,356$; ($p<0,001$). Other risk factors highlighted by occupational voice users are the ingestion of liquid caffeine, alcohol, and carbonated drinks, smoking or the presence of chronic cough, chronic laryngitis, and gastroesophageal reflux disease.

Conclusions: Occupational voice users are subjected to high daily vocal demands that can be seen to be linked to vocal fatigue, changes in voice quality and vocal symptoms experienced. It is essential that occupational voice users as well as treating clinicians are aware of certain significant predictors of both vocal handicap and vocal fatigue. These findings provide insights for developing strategies for training and cultivating vocal health consciousness and preventive voice care initiatives that focus on occupational voice users in South Africa.

Keywords: Occupational Voice Users; Vocal Demands, Vocal Perceptions and Knowledge, Vocal fatigue.

1.2 Introduction

Between 25% and 35% of the labor force is considered to be occupational voice users (OVUs).¹ These professionals' livelihoods depend on the ability to produce voice and include, but are not limited to the following professions: teachers, call-center operators, actors, singers, radio announcers, sports coaches, ministers, and attorneys.¹ Although vocal quality and load may vary, OVUs all depend on vocal endurance.¹

To the OVU, voice stability and maintenance of vocal health are essential as their voices are a critical component of their work.² Continuous voice use, or high vocal load, required occupationally may lead to voice problems.³ It has been established that OVUs are more at risk to experience voice symptoms and vocal problems when compared to the general working population.¹

Furthermore, altered voice quality, especially for OVUs, may result in reduced productivity and professional performance, restricted participation in activities, limited

vocal expression and emotional stress, as well as anxiety surrounding the risk of job loss with subsequent reduction in quality of life.^{1,2,4–7} Voice problems experienced by OVUs may lead to difficulties for both employees and employers.^{1,2,6} Employers may experience increased employee turnover, absenteeism, and additional costs for substitute workers, medical treatment, and workers' compensation claims.^{1,2,6}

When not only considering OVUs, the prevalence of voice disorders varies between 3% and 9% within the general population.³ Thus, managing vocal use is a vital skill all people must acquire, especially OVUs.⁸ The vocal mechanism is capable of extended periods of rigorous use, but does require rest and recovery time to repair damage and reduce inflammation at a cellular level caused by abuse or misuse frequently encountered in OVUs.^{3,8}

OVUs have the propensity to expose their voices to increased risk factors, not always protecting their vocal systems from excessive vocal use.^{5,9,10} Major voice risk factors include using the voice in non-favorable organic or environmental conditions such as excessive noise, prolonged voice use without rest, effortful voice use, and not reserving sufficient time to recover after an illness that affects the voice.^{1,4–9,11–15}

Recently the workforce was faced with the COVID-19 pandemic. This imposed numerous transformations on occupational, social, and leisure activities.¹⁶ Social distancing mandates led to drastic professional changes throughout the world affecting many OVUs, who had to adapt their occupational activities to deliver them virtually.¹⁶ The occurrence of vocal symptoms in OVUs was correlated with increased stress during the transition period.¹⁶ This was attributed to increased concentration on improving communication during classes, prolonged periods spent in front of the computer screen and posture, extensive use of headphones and microphones as well as new, unknown stimuli that demanded their attention creating mental overload.¹⁶ OVUs in different fields have reported increased vocal fatigue (VF), musculoskeletal pain in the cervical spinal region, vocal tract discomfort, and the development of dysphonia.¹⁶ OVUs who were working from home during the pandemic reported worsening of vocal hyperfunction, along with increased vocal intensity and effort, which led to worsening of the voice and VF.¹⁶

Generally OVUs are more susceptible to developing cumulative voice symptoms associated with VF and are therefore more at risk to voice disorders.⁹ VF is typically

defined as a range of symptoms related to the overtaxing of the larynx, leading to a chronic subjective sensation of muscular tiredness of the voice that increases with voicing activity and progresses over time.^{8,9,14,17} Symptoms are irregularities and changes in the quality of voice, including limited frequency and intensity ranges.^{8,9,14,17} Although dysphonia and VF symptoms may have a detrimental impact on the vocational and economic goals of OVUs, their quality of life, and their psychological well-being, only a few OVUs report sufficient voice training or education as a preventative measure.^{3,9,11,12,18}

A previous questionnaire-based study on the vocal demands, needs, and habits of professional TV and radio newsreaders found that most (70.2%) of participating newsreaders believed their job required extensive voice use and just over half (53.2%) found it to be vocally demanding.¹⁹ The majority (80%) of the newsreaders experienced VF, and more than half (56%) reported using voice rest or conservative voice use until their voice felt normal again.¹⁹ Contrastingly, only a small proportion of the newsreaders (19.1%) believed they had a voice problem and described symptoms such as throat pain, choking sensation, and VF during or after news reading.¹⁹ Most newsreaders, however, considered their voice essential to their occupation and felt the need to conserve it, with 77% reporting that they took active measures to conserve their voice ($p < 0,001$).¹⁹ Just over three-quarters (76.6%) of newsreaders reported that they had never been advised by a voice professional regarding voice care and almost two-thirds (65.2%) believed that they would benefit from instructions about voice care.¹⁹

Using acoustic measures such as fundamental frequency, phonation times, and estimated vocal intensity data, investigators identified that elite sports coaches experienced heavy vocal demands during player training.¹² All participants reported VF symptoms.¹² VF and hoarseness were most frequently reported in both quantitative and qualitative data.¹² Although coaches recognized their occupational reliance on voice, none had sought help from health care professionals regarding experiences of voice symptoms or problems.¹² Coaches typically did not consider supporting their voices during daily work and mentioned that voice symptoms are an inevitable part of their jobs.¹²

Voice education is frequently reported to be unsuitable or insufficient in OVUs as evidenced by the expressed desire for more education and the continued high

prevalence of voice problems.^{10,12,19} It was also noted that previous studies have mostly been conducted in high-income countries (HICs) as opposed to low-middle-income countries (LMICs), such as South Africa. Thus, the following research question is posed: What are the daily vocal demands, perceptions, and knowledge reported by occupational voice users in South Africa?

1.3 Method

Aim

The study aimed to describe daily vocal demands, perceptions and knowledge as reported by occupational voice users in South Africa.

Research design

A descriptive, cross-sectional research design was employed.²⁰

Participants

A total of 102 both male and female OVUs (call center agents, teachers, lecturers, singing students, and performing arts students) were invited to complete the vocal demands survey using a snowball sampling technique. The informed consent form and survey were sent via email as a link to the online survey; there was a 100% response rate. However, during the data cleaning process, it was found that although the Excel sheet contained 102 responses, two participants, after giving consent, did not complete any items on the questionnaire itself. These two participants were removed, giving a final sample size of 100.

Due to the study investigating an adult population, a minimum age of 18 years was set. Participants were excluded if they 1) had a pre-existing history of voice disorders as diagnosed by an otolaryngologist (ENT), as any predetermined voice pathology could influence the perceptual and acoustic analysis; 2) had previously received voice therapy, as this may cause possible bias due to previous knowledge acquired on vocal hygiene.

Factors that may have influenced voice quality such as allergies, gastroesophageal reflux disease (GERD), and sinusitis were not regarded as exclusion criteria but were taken into consideration.

Data collection procedures

Institutional review board clearance was obtained (HUM019/0321). Various employers and heads of departments (school of music and drama) were contacted and requested to inquire whether OVUs in their employment or students in their department would voluntarily participate in the proposed study. OVUs and students who were interested in participating were asked to provide their email addresses so that the online survey could be shared with them after the research study was announced by their employers/lecturers or after the primary researcher presented on the study at the participants' place of work/class. All OVUs and students participated on a voluntary basis after informed consent was obtained. One hundred were selected via snowball sampling (where current participants recruit future potential participants from among their acquaintances).²⁰ Upon written consent, surveys were distributed to participants. The survey was available via email link from the 26th of May to the 30th of June 2022.

Materials

Vocal demands survey

The vocal demands survey consisted of a voice case history questionnaire, The Voice Handicap Index (VHI-10)²¹, and The Vocal Fatigue Index (VFI)²² compiled as a single survey (Appendix E) on Qualtrics^{xm}, an online survey platform. The voice case history questionnaire was completed by each OVU in order to obtain their biographic and demographic information for an accurate description of the sample population and to confirm what category of OVU they belong to. The comprehensive case history questionnaire was completed to gather participants' voice histories regarding information, including age, profession, general health (GERD and allergies), medical history, vocal habits (smoking, alcohol consumption, and vocal abuse), and daily vocal

use/load. Participants were asked to complete the voice handicap index (VHI-10)²¹ for comparison of self-perceived voice handicap. This ten-question scaled index aimed to identify and quantify voice handicaps in the participants. Participants rated 10 voice statements (e.g., “My voice problem upsets me”) according to how applicable they are to them and their voice. Ratings are from 0-4, 0 being “never” and 4 being “always”.²¹ Participants were asked to also complete the VFI²² for comparison of self-perceived VF. The VFI is a nineteen-question scaled index used to determine whether VF is present. This also enabled the researcher to discriminate between participants with perceived dysphonia and participants with typical phonation (or phonation within normal limits). Participants rated 19 voice statements (e.g., “My voice feels tired when I talk more”) according to how applicable they were to them and their voice. Ratings are from 0-4, 0 being “never” and 4 being “always”. Three factors were examined relating to VF due to questions being separately aimed at 1. Tiredness of voice, 2. Physical discomfort and, 3. Improvement of symptoms with rest. A higher score for factors 1 and 2 indicated increased VF. Inversely, a higher score for factor 3 indicated decreased VF.²²

Data analysis

The Statistical Package for Social Sciences (SPSS) software programme version 28 was used for all data analyses. Descriptive statistics, such as means, standard deviations and percentages, and inferential statistics, are reported in this study. For the VHI, the 10 items of the VHI instrument were combined by adding the scores for the 10 items, and for the three factors of the VFI, for Factor 1 items 1 to 11 were combined, for Factor 2 the next 5 items were combined and for Factor 3 the last 3 items were combined of the total of the 19 VFI items. Since these constructs were continuous variables, normality had to be tested. The Shapiro-Wilk test²³ was used to test for differences from normality for all the continuous variables in the study with a *p*-value greater than 0.05 indicating normality. Since many of the *p*-values are less than 0.05 for many of the continuous variables considered in this study, normality could not be established for all variables and, accordingly, non-parametric methods were used, specifically, the non-parametric Spearman correlation (*rs*) was used to test for correlations between various variables. In addition, since not all variables are normally

distributed, the median (*Mdn*) and interquartile range (*IQR*) are reported along with the mean (*M*) and standard deviation (*SD*). For reporting the results, note that, since the sample size equaled 100 exactly, the frequencies and percentages are equal and, for brevity, only percentages are reported. Three multiple linear regression models were built using the same predictors, but with the dependent variable being VHI-10 (Model 1), VFI Factor 1 (Model 2), and VFI Factor 2 (Model 3), respectively. For all three models, nine predictors were used, namely; allergies, post-nasal drip, oesophageal reflux, hoarseness of voice, roughness of voice, VF, intake of liquid caffeine, and smoking. The ninth predictor indicated how often participants use their voices for work during the week. For each model, a stepwise multiple linear regression was performed, and the assumptions for this type of analysis (e.g., normality of residuals) were checked, and it was confirmed that all the necessary assumptions were met for all three models before building the models.

1.4 Results

The average age of the 100 participants was 27,4 years (*Mdn* = 24,0, *SD* = 8,7, *IQR* = 10,0). High vocal demand OVUs were targeted, thus the professionals who participated were; call center agents, teachers, lecturers, singing students, and performing arts students. Almost half of the participants (42%; *n*=42) reported having an allergy; related to either food, animal, environment, or medication, with 41% (*n*=41) reporting suffering from a post-nasal drip or GERD (39%; *n*=39). Only 5% (*n*=5) reported previous intubation (Table 1.1). More than half of the participants (55%; *n*=55) reported using their voices 33-40 hours a week for work. The average occupational voice use reported was 6,3 hours a day (Table 1.2).

Table 1.1. Participant medical characteristics (n=100)

<i>Medical Characteristics</i>	<i>%</i>
Allergy (food, animals, environmental, or medication)	42
Post-nasal drip	41
GERD	39
Hormonal treatment (contraceptives, hyperthyroidism and menopausal)	36
Prescribed chronic medication	33
Sinusitis	28
Chronic cough	17

Ear problems	15
Chronic laryngitis	9
Chronic colds	7
Previous intubation	5
Previous laryngeal procedure (tonsillectomy)	2

Table 1.2. Participant's voice use characteristics (n=100)

<i>Voice Use Characteristics</i>	<i>%</i>
Negative change in voice after work	81
Vocal fatigue after work or the following day	75
Hoarseness	70
Received previous vocal health education	61
33-40 hours of occupational voice use a week	55
Roughness	51
Breathiness	41
Felt vocal health education was insufficient	40
Often expected to shout, scream or cheer	33
Loss of voice	32
Weaker on certain pitch levels	25
Painful voice production	24
Generally softer voice	21

It was also noted (Table 1.3) that 16% (n=16) of participants reported smoking and smoked a mean of 14,5 cigarettes a day (Mdn = 12,5, SD = 5,4, IQR = 10,0). Most of the participants (82%; n=82) reported that they ingest liquid caffeine with a mean of 3,8 servings a day (Mdn = 3,0, SD = 2,7, IQR = 3,0), and just over half (55%; n=55) reported ingesting other forms of caffeine, such as tea, energy drinks, and chocolate with a mean of 1,4 servings a day (Mdn = 1,0, SD = 0,5, IQR = 1,0).

Table 1.3. Participant habits in terms of daily intake (n=100)

<i>Habits</i>	<i>%</i>	<i>M</i>	<i>Mdn</i>	<i>SD</i>	<i>IQR</i>
Smoking	16	14,5 cigarettes	12,5	5,4	10,0
Liquid caffeine	82	3,8 servings	3,0	2,7	3,0
Other forms of caffeine	55	1,4 servings	1,0	0,5	1,0
Water	93	5,9 servings	6,0	3,3	4,0
Alcohol	51	1,4 servings	1,0	0,8	1,0
Carbonated drinks	41	1,6 servings	2,0	0,9	2,0

Dairy products	76	2,4 servings	2,0	1,2	2,0
----------------	----	--------------	-----	-----	-----

When scoring the VFI, greater scores on Factors 1 (tiredness of voice) and 2 (physical discomfort) indicate greater severity of VF. Inversely, for Factor 3 (improvement of symptoms with rest), lower scores indicate increased VF. For this reason, VFI total scores are not reported, as only sub-scores are meaningful. Moreover, each Factor is conceptually different, and individual Factor scores likely provide more insight into a particular patient's experience of VF than a total score.²²

For VFI Factor 1 (tiredness of voice), a maximum score of 44 could be obtained and for this study, the average score for VFI Factor 1 was 20,65 (*Mdn* = 21,0, *SD* = 9,1, *IQR* = 15,0). For Factor 1 a score of ≥ 24 indicates a greater severity of tiredness of voice. Thus, an average score of 20,65 (*Mdn* = 21,0, *SD* = 9,1, *IQR* = 15,0) indicated normality for the perception of tiredness of voice amongst participants. However, 40% (*n*=40) of the participants scored ≥ 24 for Factor 1, indicating that some of the participants experienced an increased perception of tiredness of voice.

For Factor 2 (physical discomfort), a maximum score of 20 could be obtained and for this study, the average was 6,9 (*Mdn* = 6,0, *SD* = 3,9, *IQR* = 6,0). For Factor 2 a score of ≥ 7 indicates greater severity of physical discomfort.²² Thus, an average score of 6,9 (*Mdn* = 6,0, *SD* = 3,9, *IQR* = 6,0) being borderline, as well as 63% (*n*=63) of the participants scoring ≥ 7 for Factor 2 indicated that more than half of the participants experienced an increased perception of physical discomfort.

For Factor 3 (improvement of symptoms with rest), a maximum score of 12 could be obtained, and for this study, the average was 10,03 (*Mdn* = 11,0, *SD* = 2,3, *IQR* = 3,0). For Factor 3 a score of ≤ 7 indicates that VF does not improve with rest. Thus, an average score of 10,03 (*Mdn* = 11,0, *SD* = 2,3, *IQR* = 3,0), as well as 82% (*n*=82) of the participants scoring above 7 for Factor 3 indicated that a majority of participants experienced improvement of symptoms with rest. Table 1.4 shows that VFI Factors 1 and 2 had positive and statistically significant correlations to the VHI-10 total score being $r_s=0,783$; ($p<0,001$) and $r_s=0,369$; ($p<0,001$) respectively.

When only comparing VFI Factor scores (Table 1.4), participants' perception of tiredness of voice was positively and significantly correlated to their perception of

physical discomfort $r_s=0,425$ ($p<0,001$) as well as how OVUs experienced improvement of symptoms with rest $r_s=0,298$ ($p=0,004$).

Table 1.4. Spearman correlations between variables and Factors in the VFI (n=100)

	Factor 1. Tiredness of voice	Factor 2. Physical discomfort	Factor 3. Improvement of symptoms with rest
<i>Variable</i>	<i>Correlation (p-value)</i>		
VHI Total Score	0,783 (< 0,001)*	0,369 (< 0,001)*	0,148 (0,156)
VFI Factor 1 Score	-	0,425 (< 0,001)*	0,298 (0,004)
VFI Factor 2 Score	0,425 (< 0,001)*	-	-0,044 (0,671)
VFI Factor 3 Score	0,298 (0,004)*	-0,044 (0,671)	-
Vocal training	-0,074 (0,478)	0,003 (0,975)	0,097 (0,351)
Vocal health education	0,065 (0,534)	0,098 (0,346)	0,164 (0,114)
Was VHE sufficient?	-0,560 (< 0,001)*	-0,144 (0,268)	-0,044 (0,733)
Exposure to loud noise	0,101 (0,334)	0,147 (0,158)	-0,028 (0,792)
Expected to shout/scream/cheer	0,001 (0,994)	0,041 (0,694)	0,043 (0,683)
Change in voice quality before and after work?	0,504 (< 0,001)*	0,309 (0,002)*	0,128 (0,221)
Breathiness	0,698 (< 0,001)*	0,194 (0,061)	0,302 (0,003)*
Pain	0,352 (< 0,001)*	0,529 (< 0,001)*	-0,077 (0,460)
Hoarseness	0,587 (< 0,001)*	0,299 (0,003)*	0,252 (0,014)*
Roughness	0,600 (< 0,001)*	0,377 (< 0,001)*	0,192 (0,064)
Generally softer voice	0,366 (< 0,001)*	0,181 (0,080)	0,266 (0,010)*
Only softer on certain pitch	0,314 (0,002)*	0,263 (0,010)*	0,114 (0,274)
Loss of voice	0,560 (< 0,001)*	0,117 (0,259)	0,178 (0,086)
Vocal fatigue after work or the following day	0,498 (< 0,001)*	0,362 (< 0,001)*	0,147 (0,161)
Occupational voice use during a week	0,270 (0,008)*	0,199 (0,054)	0,118 (0,256)
Hours per day	0,327 (0,001)*	0,217 (0,038)*	0,081 (0,445)
Average duration of occupational voice use (min)	-0,271 (0,009)*	0,164 (0,199)	-0,356 (< 0,001)*
Smoking	0,270 (0,009)*	0,115 (0,271)	0,095 (0,365)
Carbonated drinks	-0,096 (0,355)	-0,074 (0,271)	-0,024 (0,821)
Servings per day	0,439 (0,005)*	0,025 (0,877)	0,281 (0,079)
Alcohol	-0,162 (0,119)	0,035 (0,737)	-0,225 (0,029)*
Servings per day	0,310 (0,032)*	0,104 (0,483)	0,117 (0,428)

Liquid caffeine	0,302 (0,003)*	0,206 (0,047)*	0,008 (0,936)
Servings per day	0,134 (0,242)	-0,063 (0,583)	0,262 (0,021)*
Other forms of caffeine	0,086 (0,414)	0,188 (0,071)	-0,091 (0,384)
Water intake	-0,169 (0,110)	0,044 (0,683)	-0,026 (0,807)
Endocrine illness or hormonal treatments	0,078 (0,453)	0,258 (0,012)	-0,167 (0,108)
Birth control	0,133 (0,200)	0,056 (0,593)	-0,074 (0,480)
Chronic medication	-0,183 (0,077)	-0,006 (0,955)	-0,218 (0,035)*
Chronic colds	0,105 (0,315)	-0,153 (0,142)	0,186 (0,073)
Chronic laryngitis	0,204 (0,049)*	0,160 (0,124)	0,084 (0,423)
Chronic cough	0,287 (0,005)*	0,114 (0,275)	0,059 (0,575)
GERD	0,274 (0,007)*	0,028 (0,791)	0,033 (0,755)

*Statistically significant: $p < 0,05$

For The VHI-10 (Table 1.5), a maximum score of 40 could be obtained and for this study, the average for VHI was 10,93 ($Mdn = 10,0$, $SD = 6,7$, $IQR = 12,0$). A VHI-10 score of more than 11 is considered abnormal indicating increased vocal handicap.²⁴ Thus, an average score of 10.93 ($Mdn = 10,0$, $SD = 6,7$, $IQR = 12,0$), being borderline, as well as 47% ($n=47$) of the participants scoring ≥ 11 indicates that on average participants experience an increased perception of vocal handicap. When comparing VHI-10 and VFI scores, an increased perception of vocal handicap (VHI-10) was positively and significantly correlated to participants' perceptions of tiredness of voice $rs=0,783$ ($p<0,001$) and physical discomfort $rs=0,369$ ($p<0,001$).

Table 1.5. Spearman correlations between variables and the VHI-10 ($n=100$)

Variable	Correlation	p-value
VFI Factor 1 Score	0,783	< 0,001*
VFI Factor 2 Score	0,369	< 0,001*
VFI Factor 3 Score	0,148	0,156
Vocal training	0,030	0,772
Vocal health education	0,151	0,144
Was VHE sufficient?	-0,582	< 0,001*
Exposure to loud noise	0,139	0,179
Expected to shout/scream/cheer	0,039	0,704
Change in voice quality before and after work?	0,368	< 0,001*
Breathiness	0,606	< 0,001*
Pain	0,322	< 0,001*
Hoarseness	0,462	< 0,001*

Roughness	0,542	< 0,001*
Generally softer voice	0,305	0,003*
Only softer on certain pitch	0,229	0,026*
Loss of voice	0,527	< 0,001*
Vocal fatigue after work or the following day	0,413	< 0,001*
Occupational voice use during a week	0,242	0,018*
Hours per day	0,147	0,161
Average duration of occupational voice use (min)	-0,189	0,070
Smoking	0,174	0,092
Carbonated drinks	-0,153	0,139
Servings per day	0,324	0,042
Alcohol	-0,040	0,703
Servings per day	0,301	0,036*
Liquid caffeine	0,238	0,020*
Servings per day	0,069	0,543
Other forms of caffeine	0,109	0,297
Water intake	-0,204	0,052
Endocrine illness or hormonal treatments	0,082	0,430
Birth control	0,076	0,465
Chronic medication	-0,136	0,188
Chronic colds	0,054	0,600
Chronic laryngitis	0,212	0,039*
Chronic cough	0,173	0,093
GERD	0,335	0,001*

*Statistically significant: $p < 0,05$

Vocal symptoms (Table 1.6) such as breathiness $rs=0,356$ ($p<0,001$), hoarseness $rs=0,238$ ($p=0,020$), roughness $rs=0,456$ ($p<0,001$), softer voice on certain pitch $rs=0,207$ ($p=0,044$), loss of voice $rs=0,227$ ($p=0,027$) and vocal fatigue $rs=0,437$ ($p<0,001$) were positively and significantly correlated with high voice use (33-40 hours a week).

Table 1.6. Spearman correlations between high voice use and participant vocal symptoms, habits and medical characteristics (n=100)

Variable	Correlation	p-value
Change in voice quality before and after work?	0,159	0,123
Breathiness	0,356	< 0.001*
Pain	0,194	0,060

Hoarseness	0,238	0,020*
Roughness	0,456	< 0.001*
Generally softer voice	0,050	0,628
Only softer on certain pitch	0,207	0,044*
Loss of voice	0,227	0.027*
Vocal fatigue after work or the following day	0,437	< 0.001*
Smoking	0,110	0,287
Carbonated drinks	-0,150	0,147
Dairy products	-0,050	0,628
Alcohol	0,026	0,802
Liquid caffeine	0,183	0,076
Other forms of caffeine	-0,109	0,297
Water intake	-0,040	0,295
Allergies (food, animals, environmental, or medication)	-0,059	0,571
Post-nasal drip	-0,131	0,205
GERD	-0,002	0,983
Endocrine illness or hormonal treatments (contraceptives, hyperthyroidism and menopausal)	0,115	0,266
Sinusitis	-0,037	0,724
Chronic cough	0,033	0,747
Ear problems	-0,011	0,915
Chronic laryngitis	0,186	0,072
Chronic colds	-0,077	0,461
Previous intubation	-0,006	0,950
Previous laryngeal procedure (tonsillectomy)	-0,005	0,965

*Statistically significant: $p < 0,05$

In the VHI multiple regression model, the stepwise procedure retained three predictors, namely, oesophageal reflux ($\beta = 3.221$, $p=0.005$), roughness of voice ($\beta = 5.100$, $p<0.001$) and VF ($\beta = 3.267$, $p=0.036$), and they explained 36.9% of the variation in the dependent variable (VHI-10). The results indicated that the model was a significant predictor of vocal handicap, $F(3,69) = 18.720$, $p<0.001$. Thus, the presence of esophageal reflux, roughness of voice and increased VF were all significant predictors of vocal handicap within the VHI.

In the VFI Factor 1 multiple regression model, the stepwise procedure retained four predictors, namely, roughness of voice ($\beta = 5.016$, $p=0.004$), hoarseness of voice ($\beta = 5.272$, $p<0.006$), smoking ($\beta = 4.031$, $p=0.032$), and VF ($\beta = 4.462$, $p=0.032$), and they

explained 45.5% of the variation of tiredness of voice (VFI Factor 1). The results indicated that the model was a significant predictor of tiredness of voice, $F(0,455) = 19.826$, $p < 0.001$. Thus, roughness, hoarseness, and smoking were all significant predictors of tiredness of voice (Factor 1) within the VFI.

In the VFI Factor 2 multiple regression model, the stepwise procedure retained three predictors, namely, roughness of voice ($\beta = 1.886$, $p = 0.016$), allergies ($\beta = 1.695$, $p < 0.017$), and VF ($\beta = 2.333$, $p = 0.020$), and they explained 22.5% of the variation of physical discomfort (VFI Factor 2). The results indicated that the model was a significant predictor of physical discomfort, $F(0,255) = 9.265$, $p < 0.001$. Thus, roughness of voice, allergies, and VF were all significant predictors of physical discomfort (Factor 2) within the VFI.

4.5 Discussion

The results of this study reveal that OVUs in South Africa are faced with high occupational vocal demands as slightly more than half of the participants (55%) reported using their voice for work 36,5 hours a week on average ($SD = 15,5$, range: 33-40). Participants indicated that, on average, they use their voice for work 6,3 hours a day which nearly equates to full working days (8 hours), five days a week. This is similar to previous studies where various OVUs reported high daily vocal demands.^{13,25}

A study investigating primary school teachers reported 5–6 hours of daily occupational voice use with little or no opportunity for vocal rest equating to 25 and 30 hours a week.²⁵ Previously, Jewish cantors self-reported at least 45 hours per week as part of their cantorial duties.¹³ Another study that followed full-time newsreaders found that they were expected to read the news 6–7 days a week with occupational voice use averaging 5 hours daily.²⁶ Other studies using dosimeters have measured occupational voice use over durations spanning a full workday, to more than a week.^{27–32}

When comparing high vocal demands OVUs experience as indicated by VHI-10 and VFI Factor scores in this study, a significant correlation was seen between high vocal demands and high degrees of perceived vocal handicap $r_s = 0,242$; ($p = 0,018$), increased tiredness of voice $r_s = 0,270$; ($p = 0,008$), physical discomfort $r_s = 0,217$; ($p = 0,038$) and improvement of symptoms with rest $r_s = -0,356$; ($p < 0,001$).

High vocal demands in OVUs are seen to be accompanied by VF, changes in voice quality, and vocal symptoms, as a majority (81%) of participants reported a negative change in their voices after work. This negative change in voice that OVUs reported was positively and significantly correlated to perceived vocal handicap, tiredness of voice, and physical discomfort. Three-quarters (75%) reported VF as their voice feels tired after a day of work or the following day and this was also positively and significantly correlated to vocal handicap, tiredness of voice, and physical discomfort. Studies have shown that VF was the most common voice complaint amongst TV and radio broadcasters.²⁶ Teachers reported that symptoms of VF included feelings of laryngeal discomfort, and pain that affect their effectiveness at work and ultimately their quality of life.⁷ Previous literature on singers supports this by revealing that VF symptoms may have a detrimental impact on the vocational and economic goals of professionals and preprofessional voice users, and consequently in their quality of life and psychological well-being.⁹

Participants in this study reported experiencing vocal symptoms such as hoarseness (70%), roughness (51%), breathiness (41%), loss of voice (32%), weaker voice on certain pitch levels (25%), painful voice production (24%), or generally softer voice (21%). This is similar to other studies where OVUs reported vocal symptoms such as; hoarseness, roughness, breathiness, loss of voice, decreased pitch range, throat and cervical spinal pain, decreased loudness, dryness in the throat, VF, muscle tension, insufficient breath support, pitch and phonation breaks, throat clearing, globus (“lump in the throat”), tickling, asthenia, choking sensation, strain, and ardor.^{2,6,11,12,14,17,26,33,34} VF and hoarseness were the most commonly reported symptoms in previous studies.^{12,34} According to these reports, OVUs are at risk for increased VF, changes in voice quality, and vocal symptoms.

One must also consider the ramifications of the COVID-19 pandemic as an environmental risk factor that exacerbated the above-mentioned voice use demands, VF, and vocal symptoms OVUs experience. OVUs were confronted with what they perceived as stressful and unfavorable environmental conditions in which they needed to perform their occupational tasks.³⁹ For many it was compulsory to wear a face mask if they were permitted to work in public spaces. A study by Ribeiro et al.(2020) indicated an increase in the perception of vocal effort, difficulties in speech intelligibility, auditory feedback, and coordinating speech and breathing in OVUs who use face

masks for professional activities.⁴⁰ Numerous OVUs were forced to work from home during the COVID-19 pandemic in order to comply to social distancing regulations. In the remote working model, there is a high demand for meetings on digital platforms requiring loud and clear vocal quality for extended periods of time.¹⁶ A recent study found that OVUs working remotely presented with increased musculoskeletal pain in the cervical spinal region and vocal fatigue, whereas OVUs who continued to work in public spaces presented with vocal fatigue and increased pain in the laryngeal region.¹⁶ OVUs who now needed to work from home and complete occupational tasks virtually have also reported they experienced more vocal hyperfunction due to using increased vocal intensity and effort with the use of microphones and headsets resulting in the cumulative development of dysphonia.^{16 40,41}

Pertinent findings revealed that certain predictors are significantly linked to higher VHI and VFI scores and thus increased vocal handicap and VF in OVUs. It can be beneficial for OVUs to note that esophageal reflux, roughness of voice, and VF are significant predictors of vocal handicap. Furthermore, roughness of voice, hoarseness of voice, and smoking are significant predictors of tiredness of voice whereas roughness of voice, allergies, and VF predicted physical vocal discomfort. A multiple regression model was not conducted for VFI Factor 3 as the results revealed that the VHI and VFI Factor 2 did not significantly correlate to VFI Factor 3.

Another risk factor that should be noted is that approximately one-third (33%) reported that they often attend events or are exposed to environments where they are expected to shout, scream or cheer loudly. This indicates that some participants engage in vocal misuse and abusive behaviors that could further contribute to VF, changes in voice quality and vocal symptoms experienced. Vocal abuse and misuse patterns are commonly noticed in OVUs.^{2,12,26,33,35} Literature shows that OVUs likely engage in prolonged and continuous voice use with only occasional periods of voice rest, loud and effortful talking, and unergonomic postures.²⁶ Research suggests several commonly occurring risk factors that impact the vocal health of OVUs.¹² These factors include various ergonomic and individual factors such as: lengthy duration of voice use; yelling over distances; room acoustics; poor posture; background noise; quality of air; irritants; frequent habitual throat-clearing; lack of vocal health awareness; stress; anxiety and workload demands^{2,12,26,33} These improper vocal behaviors and compounding risk factors may cause variations in vocal quality, reduced vocal range,

and limited flexibility in voice and, occasionally, inflammation of the vocal folds that subsequently result in vocal fold pathology.²⁶

Regarding vocal hygiene education (VHE), more than half of the participants (61%) reported that they have previously received VHE on how to care for their voice but 40% reported that they felt this training was insufficient. This is parallel to previous studies where OVUs reported that vocal training or VHE was lacking during preparation for their profession.^{3,9,12,18,19,36} The perception of insufficient VHE amongst OVUs was also significantly correlated to tiredness of voice and vocal handicap. Many OVUs view voice problems as an occupational hazard but may not be aware of the help available to them.² In a study on the impact of voice disorders among teachers—vocal complaints, treatment-seeking behavior, knowledge of voice care, and voice-related absenteeism—reported that only 27% of teachers received knowledge about vocal care, vocal hygiene, and vocal techniques.³⁷ VHE as it is currently delivered to this population appears to be unsuitable or insufficient as evidenced by the expressed desire for more education and the continued high prevalence of voice problems reported by various OVUs.¹¹

Lack of VHE is evident when evaluating OVUs' vocal health habits and diet. A positive and significant correlation was found between OVUs ingesting high amounts of liquid caffeine and perceived vocal handicap, tiredness of voice, physical discomfort, and improvement of symptoms with rest. Increased alcohol intake was also positively and significantly correlated to perceived vocal handicap, tiredness of voice, and improvement of symptoms with rest. OVUs who reported being smokers and ingesting high amounts of carbonated drinks positively and significantly correlated to tiredness of voice. OVUs' Internal risk factors must also be considered as reported chronic laryngitis and GERD were positively and significantly correlated to perceived vocal handicap and tiredness of voice. Chronic cough was also positively and significantly correlated to tiredness of voice. This is comparable to previous studies where OVUs reported smoking, a high intake of liquid caffeine, carbonated drinks, alcohol as well as the presence of GERD.^{13,18,26,33,38} Reflux disorders are a common concern for various OVUs.^{13,38} These problems concerning vocal hygiene in OVUs can adversely impact vocal fold function, resonance, and vocal endurance.¹³

Limitations and recommendations

There are potential limitations to the current study which warrant mention. The sample included in this study was a group of mostly young (average age 27 ($SD = 8,7$)), vocally healthy OVUs. It may be that age and vocal health influence knowledge and perceptions reported, and it is therefore recommended that future research should be conducted on a sample with greater age variation. It may also, however, be advantageous that the cohort was younger as the findings emphasize the importance and need for early intervention in this population. It is recommended that future research studies consider a broader variety of occupational groups that may benefit from the results and focus on profession-specific outcomes.

1.6 Conclusion

Based on the perceptions and knowledge reported it can be concluded that OVUs are subjected to high daily vocal demands that can be linked to VF, changes in voice quality and vocal symptoms experienced. High vocal demands are significantly correlated to an increase in perceived vocal handicap, tiredness of voice, and physical discomfort as well as how OVUs experience improvement of symptoms with rest. It is essential that OVUs as well as treating clinicians are aware of certain significant predictors of both vocal handicap and VF. GERD, roughness of voice, and VF have been identified as significant predictors of vocal handicap. Roughness of voice, hoarseness of voice, and smoking are significant predictors of tiredness of voice whereas roughness of voice, allergies, and VF significantly predict physical vocal discomfort.

Although many OVUs report that they have previously received VHE, almost half report that this training was insufficient. Other risk factors highlighted in OVUs are the ingestion of liquid caffeine, alcohol, and carbonated drinks, smoking or the presence of chronic cough, chronic laryngitis, and GERD. These findings provide insights for developing strategies for training and cultivating vocal health consciousness and preventive voice care initiatives that focus on OVUs in South Africa. It should be noted that although South Africa is an LMIC, results reveal similar findings to previous studies done in HICs.^{3,7,9,12,13,25,26} OVUs are still faced with equally high vocal demands that

are accompanied by VF and vocal symptoms and a reported lack of VHE. The challenges that the OVUs all over the world face, make them more susceptible to vocal risks that may cause altered laryngeal function, inability to perform their occupational activities, and, in severe cases, contribute to vocal problems that may affect their psychological well-being and professional lives.⁹ The importance of an early diagnosis or detection of changes in vocal function in this group must not be underestimated.

1.7 Funding Sources

The University of Pretoria.

1.8 Disclosure Statement

The authors have no conflicts of interest to declare.

1.9 References

As mentioned in former references lists within this thesis as well as the following:

1. Field PA. *Discovering Statistics Using IBM SPSS Statistics*. 5th ed. Thousand Oaks, California: SAGE Publications Inc.; 2018.
2. Arffa RE, Krishna P, Gartner-Schmidt J, Rosen CA. Normative values for the voice handicap index-10. *J Voice*. 2012;26(4):462-465. doi:10.1016/j.jvoice.2011.04.006
3. Gaskill CS, O'Brien SG, Tinter SR. The effect of voice amplification on occupational vocal dose in elementary school teachers. *J Voice*. 2012;26(5):667.e19-667.e27. doi:10.1016/j.jvoice.2011.10.010
4. Karulkar RR, Gunjawate DR. Voice-Related Problems, Vocal and Non-Vocal Habits in Naradiya Kirtankars: A Preliminary Study. *J Voice*. 2021. doi:10.1016/j.jvoice.2021.05.020
5. Houtte E Van, Claeys S, Wuyts F, Lierde K Van. The Impact of Voice Disorders Among Teachers: Vocal Complaints, Treatment-Seeking Behavior, Knowledge of Vocal Care, and Voice-Related Absenteeism. *J Voice*. 2022;25(5):570-575. doi:10.1016/j.jvoice.2010.04.008

LEARNING OUTCOMES

As a result of this activity/article, the participant will be able to list the pertinent risk factors OVUs are faced on a daily basis.

As a result of this activity/article, the participant will be able to describe significant predictors of vocal handicap and vocal fatigue.

As a result of this activity/article, the participant will be able to assess the importance of developing strategies for training and cultivating vocal health consciousness and preventive voice care initiatives that focus on OVUs in South Africa.

CHAPTER 5

THE OUTCOMES OF THE VOICE USE REDUCTION PROGRAMME ON VOCAL QUALITY AND VOCAL FATIGUE IN OCCUPATIONAL VOICE USERS

Authors: Vermeulen, R., du Toit, M., van Lierde, K., Graham, A.M. & van der Linde, J

Journal: Submitted to: *Folia Phoniatrica et Logopaedica*.

Impact factor: 1.391

Date submitted: 5 June 2023

Proof of submission: Appendix K

Note: This article was edited in accordance with the editorial specifications of the journal and may differ from the editorial style of the rest of this document.

1.1 Abstract

Introduction: Occupational voice users' [OVUs] livelihoods depend partially or completely on their voice, however the prevalence of voice disorders in OVUs are rising due to increased daily vocal demands. The purpose of this research article is to describe the outcomes of the Voice Use Reduction [VUR] programme on voice quality and vocal fatigue in OVUs.

Methods: A within-subject, quasi-experimental, pre-test post-test research design was performed on 30 OVUs. Perceptual and acoustic outcome measures were employed pre-and post-implementation of the VUR, including the GRBASI 4-point rating scale, jitter, shimmer, F_0 , HNR, MPT, frequency min and max, intensity min and max, and the dysphonia severity index [DSI] and perceived vocal fatigue [VF] using the Vocal Fatigue Index [VFI].

Results: Pre- and post-test outcomes show significant [$p < 0.001$] decreases in G [Grade of hoarseness], R [Roughness], A [Asthenia], S [Strain], and I [Instability] in the post-test. Perceptual normality in all of these areas increased significantly [$p < 0.001$].

Acoustic measures revealed significant [$p < 0.05$] decreases in *Jitter%*, Intensity [dB] Min and DSI scores as well as significant [$p < 0.05$] increases in MPT /a/,/s/ and /z/, Frequency [Hz] Max, and F_0 [Hz] Max, indicating improved voice quality at post-test. The VUR programme positively affected and improved OVUs' perception of VF in the areas of tiredness of voice and physical discomfort.

Discussion/Conclusions: The VUR programme significantly reduced the degree of dysphonia seen in OVUs as seen in perceptual and acoustic outcomes. Overall VF was also significantly improved and the prevailing sentiment appears to be that OVUs strongly perceive improvement of VF symptoms with rest regardless of the current level of VF they are experiencing. When approaching OVUs, clinicians are encouraged to make use of a combination direct voice therapy and vocal hygiene accompanied by the use of VUR to help develop healthier use of the voice, facilitate healing and prevent further/future injury.

Keywords: Occupational Voice Users; Voice Use Reduction Programme; Vocal Quality; Vocal Fatigue.

1.2 Introduction

Occupational voice users' [OVUs] livelihoods depend partially or completely on their voice, however the prevalence of voice disorders in OVUs are rising due to increased daily vocal demands [1,2]. As a result, voice management and vocal health of the OVU has received renewed attention [3–10]. Four levels of OVUs have previously been defined. 1. Elite vocal performers [singers, actors], 2. professional voice users [clergy, lecturers, telephone operators], 3. non-vocal professionals [other teachers, doctors, lawyers] and 4. non-vocal non-professionals [labourers, clerks] [11]. Although expectations placed on different OVUs pertaining to vocal load, voice quality, and vocal sophistication may differ, all OVUs depend on vocal stability and endurance [12]. Regrettably, patterns of vocal misuse and abuse are frequently noted in OVUs which can often result in voice disorders [12]. Extended periods of continuous and excessive voice use without rest, unnatural voicing postures, effortful talking and increased volume are often expected from the OVU [13] in environments that are often less than optimal for vocal health [7]. Cumulatively, daily voice demands, vocal misuse and abuse and environmental factors all place OVUs at risk to phonotrauma [4,5].

A “vocal effort loop” has been theorized, in which tensions within the vocal mechanism feed upon each other and grow, creating harmful vocal use patterns that can be very difficult to correct [14]. These disruptions can impede an OVU’s ability to communicate effectively and ultimately perform occupational tasks [15]. Research reveals that vocal fatigue [VF] symptoms have a detrimental impact on economic and vocational goals of future OVUs and OVUs, consequently also affecting their psychological well-being and quality of life [6,12,16,17]. An OVU’s ability to communicate effectively has a significant influence in the workplace [2].

Literature suggests that when voice problems arise, employees exhibit reduced productivity, reduced work quality, restriction of occupational activities, and increased absenteeism [2,18]. Employers note increased costs for substitute workers, employee turnover, medical treatment, and workers’ compensation claims due to persisting voice disorders [2]. Due to the sequelae of negative consequences VF can have within this population, it is imperative that OVUs acquire voice care knowledge and implement vocal hygiene [VH] practices in order to circumvent resulting voice disorders [19].

In an effort to prevent voice disorders in OVUs, the implementation of vocal hygiene education [VHE] programmes is endorsed [17]. The main goals of VHE programmes are to educate individuals regarding practices to ensure vocal health, balancing muscles for optimal vocal production and keeping the vocal folds and surrounding structures free of lesions and pathology, particularly for OVUs [7,17,18]. Consequently, VHE programmes require modifications in daily routines to directly improve vocal health [6,12]. It is clear that the importance of VH to the OVU is proportionate to the professional demands of voice use [20]. Although some OVUs receive various degrees of training on aspects of VH, their needs for vocal protection through VH practices are lifelong [5].

Voice use reduction [VUR], voice conservation or modified voice rest¹ is central to VHE programmes and can be used as a method to adapt daily routines aimed at directly enhancing vocal health [21]. Despite the common recommendation for voice rest, a consensus regarding the specifics of implementation of type and duration of voice rest varies among clinicians [22]. The recommendation of absolute voice rest, or complete

¹ A concept hereafter referred to as voice use reduction [VUR].

silence, has become controversial over the decades as more recent studies suggest that the benefit from this practice is questionable [22,23] and may even lead to negative psychological effects on the client and deconditioning of the vocal apparatus as a finely tuned occupational tool [22]. A prospective randomized study comparing voice rest after phonosurgery classified as either 'relative' or 'absolute' identified that relative vocal rest resulted in increased improvement in vocal stamina and long-term recovery when compared to absolute voice rest [24]. Thus, complete or absolute voice rest of more than three days is presently limited to medical diagnoses of acute laryngitis, laryngeal trauma, and as postoperative laryngeal surgery guidelines [22]. In contrast, relative voice rest/VUR practices remain popular [21,22] and are commonly recommended for anywhere between a few days to months, depending on severity and expected outcomes. A previous study suggested short term [7 days or less] relative voice rest, followed by 1-4 weeks of gradual reintroduction of voice for acute overuse [25]. This is similar to the VUR programme, as it gradually increases voice use in stages until the voice has recovered [21].

A structured behaviour modification approach to VUR, the VUR programme [21], has been suggested by van der Merwe [2004]. Currently, it is the only programme that utilizes a controlled period of reduced daily voice use in order to enhance vocal health and quality, reduce VF, and improve vocal-fold appearance [21]. The VUR programme permits VUR by calculating the maximum units of voice use per day and per week in severe, moderate, and low VUR stages [17]. It is suggested that VUR may facilitate the process of tissue repair and precipitate the process of tissue re-epithelialization, which can be a useful preventative tool when treating vocal pathology and voice disorders [21,22]. Although a formalised approach to VUR [21] is available, the effect this approach has is yet to be determined. Thus, the VUR programme [21] must be tested for the potential to be a simple, accurate, and sustainable solution to individualized management of daily voice use in OVUs. It is hypothesized that OVUs will have a significant improvement in vocal quality and vocal fatigue outcomes through the use of the VUR programme. Therefore, the following research question is posed: What is the effect of the VUR programme, on voice quality and vocal fatigue in OVUs?

1.3 Materials and Methods

1.3.1 Aim

The aim of this study was to determine the outcomes of the VUR programme [21] on voice quality and vocal fatigue in OVUs.

1.3.2 Research design

A within-subject, quasi-experimental, pre-test post-test research design was employed [26].

1.3.3 Participants

A total number of 30 male and female OVUs were invited to participate in this study using a random sampling technique. Due to the study investigating an adult population, a minimum age of 18 years was set. The professionals who participated were; call centre agents, teachers, lecturers, singing students and performing arts students.

Only OVUs who were not diagnosed with previous voice disorders by an otolaryngologist [ENT] or current infection or disease affecting vocal fold functioning were included, as these would have influenced perceptual and acoustic results. OVUs were excluded if they received prior voice therapy, as this may cause possible bias due to previous knowledge acquired on VUR. Factors that may have influenced voice quality, such as allergies, gastroesophageal reflux disease [GERD], sinusitis, and so forth, were not regarded as exclusion criteria, but were taken into consideration.

1.3.4 Voice assessment protocol

IRB approval was obtained for this study before data collection procedures commenced [HUM019/0321]. A case history questionnaire was completed to gather the participants' voice histories and information including age, level of voice training, general health [reflux and allergies], medical history, and vocal habits [smoking, alcohol consumption, and vocal abuse]. Participants were also asked to complete the vocal fatigue index [VFI] [27] pre- and post-test for comparison of self-perceived vocal fatigue. Participants completed the VFI before and after the 8-week VUR programme was implemented [pre- and post-test]. The VFI is a nineteen-question scale used to quantify the amount of vocal fatigue suffered by a given individual and discriminate between those with dysphonia and those without. Participants rated 19 voice

statements [e.g., “My voice feels tired when I talk more”] according to how applicable they were to them and their voice. Ratings were from 0-4, 0 being “never” and 4 being “always”. Three factors were examined relating to vocal fatigue due to questions being separately aimed at 1. Tiredness of voice, 2. Physical discomfort and, 3. Improvement of symptoms with rest. With factors 1 and 2 increased vocal fatigue was indicated by a higher score. Inversely, with factor 3, an increased score indicated decreased vocal fatigue [27].

Participants received a comprehensive voice assessment in order to establish a baseline for vocal quality. COVID-19 regulations were strictly adhered to at all times. Perceptual and acoustic voice parameters were measured before and after the VUR programme was implemented [pre- and post-test]. The GRBASI 4-point rating scale [28] was used to rate the perceptual quality of the participant’s voices as they were instructed to read the phonetically balanced rainbow passage [29]. Audio recordings of the voices of each participant were made using a cellular phone [iPhone 12 Pro Max] in a MPEG-4 codec format. The recordings were all made within the soundproof voice laboratory to eliminate background noise and standardize acoustics and the phone was held at a fixed distance of 10 cm from the mouth to obtain the most consistent results across different participants and to obtain clear, optimal quality recordings [30,31]. Only one recording was rerecorded due to the request of the participant. A listeners panel of five qualified speech-language therapists was used to score the perceptual data as a previous study on the reliability in perceptual analysis of voice quality, found that even when a small number of listeners are used, inter-rater reliability remains high [32]. The voice recordings were presented in random order to remove bias. Each member of the panel of listeners gave a rating for each component of the GRBASI scale, and a consensus was reached by majority vote for each component. Being blind to which recordings were from the pre- or post-test groups, increased the objectivity and reliability of the listeners panel rating of perceptual measures. Majority consensus was reached through independent scoring in a quiet room, in one session.

The maximum phonation time [MPT] of all participants was taken using the steady state vowel /a/ after maximum inspiration. Thereafter, an s/z ratio was calculated by producing the voiceless /s/ and voiced /z/ on maximal inspiratory effort for as long as possible. The best of three attempts was recorded for both MPT and s/z ratio. MPT was considered normal when greater than or equal to 15.1 seconds [33].

Multidimensional voice program analysis [MDVP] and the voice range profile [VRP] of the computerized speech lab [CSL] [MODEL 4105B; KayPENTAX] was conducted on all the participants in a sound-proof voice laboratory. Acoustic analysis of the voice was accomplished using a microphone set 10cm away from the mouth. The MDVP was used to evaluate the jitter [*jitt* %], shimmer [*shim* %], fundamental frequency variation [vF_0] and harmonic-to-noise ratio [*HNR*] of each participant by recording the steady state vowel /a/ after maximum inspiration. The VRP depicted the participant's minimum and maximum volume and pitch capacities across their vocal range.

The dysphonia severity index [DSI], a multi-parametric tool, was employed to generate an objective vocal quality score based on acoustic results [34]. A score was then generated using the maximum phonation time [MPT in seconds], highest frequency [Hz], lowest intensity [dB] and jitter [%]. The following set of voice measurements was taken into consideration when calculating the DSI [as per the equation below]; maximum phonation time [MPT in seconds], highest frequency [F_0 [F_0 high in Hz], lowest intensity [I—low in dB], and jitter [%] [35].

$$DSI = 0.13 \times \text{MPT[s]} + 0.0053 \times F_0[\text{High [Hz]}] - 0.26 \times \text{I-Low [dB]} - 1.18 \times \text{Jitter [%]} + 12.4$$

Adult norms indicate that values of $DSI > 0$ are normal, while values in the range of $-5 < DSI < 0$ may be considered either severely, moderately, or mildly dysphonic. These norms were used as a guideline [35].

Participants were asked to use the VUR programme [21] [Appendix A] daily for eight weeks. All of the participants' problematic vocal behaviours were identified and specified in quantitative terms, quantifiable goals were set, and the participant was guided on how to apply the programme. Progress, adherence and implementation was monitored by both the participant and the researcher weekly by reporting and charting voice use units in face-to-face feedback sessions. Participants were only allowed to use a predetermined number of units per day and week. The VUR programme is normally started at stage one [severe VUR] and gradually, as the voice improves, progresses to stage two [moderate VUR] and finally, ends in stage three [low VUR]. In this study, there were no participants that presented with a current diagnosis of organic vocal-fold pathology, and therefore the VUR was started for all participants [$n=30$] at moderate VUR [stage two] as severe VUR [stage one] is only intended for patients

presenting with vocal-fold pathology [21]. The duration of the stages was dependent on the improvement of the condition of the vocal folds, vocal quality, vocal fatigue, vocal effort and laryngeal pain levels. When progressing through the stages of the VUR Programme, more voice use units were allowed per day and week. Progress was tracked through the use of the VUR programme graphs [Appendix B], as well as perceptual and acoustic voice analysis and the administration of the VFI before and after implementation of the VUR programme. Almost all of the participants [96.7%; n=29] spent four weeks in stage two [moderate VUR] and then progressed to stage three [low VUR] for four weeks. Only one participant [3.3%] remained in stage two [moderate VUR] for five weeks before progressing to stage three [low VUR] as they had not experienced sufficient improvement in vocal quality or reduction of vocal fatigue by the end of week four. All participants were reassessed with the aforementioned protocol after the eight-week VUR programme was completed in order to determine post-test outcomes. All assessments were conducted by the researcher, a qualified speech-language pathologist, at the Voice Laboratory at the University of Pretoria and scheduled at the same time of day for initial assessment and reassessment to reduce variables such as vocal fatigue's possible effect on outcomes.

1.3.5. Data analysis

The Statistical Package for Social Sciences [SPSS] software programme version 28 was used in all data analyses. Since the sample size was less than 50, Shapiro-Wilk's statistic was used instead of the Kolmogorov-Smirnov statistic to test for normality with a p-value greater than 0.05 indicating normality. Since many of the p-values were less than 0.05 for many of the continuous variables considered in this study, normality could not be assumed for all variables, and, accordingly, nonparametric methods were used.

For continuous variables, the Wilcoxon signed-rank test and the Mann-Whitney test were used to determine statistically significant differences for related/dependent and unrelated/independent samples, respectively. For categorical variables, McNemar's test was used to determine whether the frequencies differed statistically significantly between the pre- and post-test data. For Likert-type ordinal data [the GRBAS], the Mann-Whitney test was used to test for statistically significant differences between unrelated/independent samples. In addition, since not all variables are normally

distributed, the median [*Mdn*] and interquartile range [*IQR*] are reported along with the mean [*M*] and standard deviation [*SD*].

1.4 Results

The average age of the 30 participants was 27,4 years [*Mdn* = 24.0, *SD* = 8.7, *IQR* = 10.0]. Almost all participants were female [93.3%; *n* = 28], with only two [6.6%] being male. High vocal demand OVUs were targeted, thus, the professionals who participated were; call centre agents, teachers, lecturers, singing students and performing arts students.

Table 1.1. Participant medical, voice-use, emotional and intake characteristics (n=30)

Medical Characteristics	Pre-test	Post-test
GERD	73.3% (n=22)	43.3% (n=13)
Allergy (food, animals, environmental, or medication)	73.3% (n=22)	30.0% (n=9)
Hormonal treatment (contraceptives, testosterone)	43.3% (n=13)	33.3% (n=10)
Prescribed chronic medication	43.3% (n=13)	20.0% (n=6)
Post-nasal drip	43.3% (n=13)	20.0% (n=6)
Ear problems	43.3% (n=13)	16.7% (n=5)
Sinusitis	43.3% (n=13)	20.0% (n=6)
Chronic colds	3.3% (n=1)	3.3% (n=1)
Previous intubation	3.3% (n=1)	3.3% (n=1)
Previous laryngeal injuries	3.3% (n=1)	3.3% (n=1)
Previous laryngeal procedure (tonsillectomy)	3.3% (n=1)	3.3% (n=1)
Family history of voice problems	3.3% (n=1)	3.3% (n=1)
Asthma	0.0% (n=0)	0.0% (n=0)
Chronic cough	0.0% (n=0)	0.0% (n=0)
Chronic laryngitis	0.0% (n=0)	0.0% (n=0)
Voice Use Characteristics		
Voice use in noisy or dusty environments	100.0% (n=30)	100.0% (n=30)
Sings often	100.0% (n=30)	100.0% (n=30)
Symptom/complaint improves with rest	100.0% (n=30)	100.0% (n=30)
Throat clearing	96.7% (n=29)	96.7% (n=29)
Experiences sensory symptoms (dryness, lump in throat, pain)	93.3% (n=28)	93.3% (n=28)

Experiences vocal fatigue or laryngeal discomfort	90.0% (n=27)	90.0% (n=27)
High voice use (8 hours a day)	90.0% (n=27)	90.0% (n=27)
Symptom/complaint worsens with continued voice use	90.0% (n=27)	90.0% (n=27)
Perceived worst voice production - Evening	76.7% (n=23)	76.7% (n=23)
Compensates with use of “another voice/pitch”	76.7% (n=23)	76.7% (n=23)
Perceived best voice production - Morning	70.0% (n=21)	70.0% (n=21)
Mouth breathing	66.7% (n=20)	66.7% (n=20)
Emotional Characteristics		
Bodily signs of tension (neck, throat, back)	100.0% (n=30)	100.0% (n=30)
Stressful work or home environment	96.7% (n=29)	96.7% (n=29)
Connection noted between voice and psychological state	96.7% (n=29)	96.7% (n=29)
Stressed emotional state	90.0% (n=27)	76.7% (n=23)
Intake Characteristics		
Water	100.0% (n=30)	100.0% (n=30)
Caffeine	46.7% (n=14)	30.0% (n=9)
Carbonated drinks	26.7% (n=8)	20.0% (n=6)
Smoking	3.3% (n=1)	3.3% (n=1)

In Table 1.1, just below three-quarters of the participants reported suffering from GERD [73.3%; n = 22]. Only one participant [3.3%] reported a family history of voice problems. All of the participants [100.0%; n = 30] reported using their voice in noisy and dusty environments, singing often and that their voice symptoms improved with rest. 90.0% of participants reported [n = 27] using their voice 8 hours a day for occupational reasons, vocal fatigue or laryngeal discomfort, and that their symptoms worsen with continued voice use. Two-thirds of the participants [66.7%; n = 20] reported mouth breathing.

All of the participants [100.0%; n = 30] reported bodily signs of tension. Almost all of the participants reported a stressful work or home environment [96.7%; n = 29], understanding the connection between voice and psychological factors [96.7%; n = 29] and experiencing a stressed emotional state [90.0%; n = 27].

All participants reported drinking water daily, with two-thirds [66.7%; n = 20] reporting drinking 2 litres per day, just below one-third [30.0%; n = 9] reporting drinking only 1 litre per day, and one participant [3.3%] reporting drinking 4 to 6 glasses a day [between 1 and 2 litres per day]. Only one participant [3.3%] reported smoking.

Table 1.2 Frequency Distribution of GRBASI scores (n=30)

GRBASI		Comparison	Normal (Score=1)	Slight (Score=2)	Moderate (Score=3)
G	Grade of Hoarseness	Pre-test	10.0% (n=3)	90.0% (n=27)	0% (n=0)
		Post-test	86.7% (n=26)	13.3% (n=4)	0% (n=0)
		z-value	-4.796	4.796	-
		p-value	<0.001*	<0.001*	-
R	Roughness	Pre-test	16.7% (n=5)	33.3% (n=10)	50.0% (n=15)
		Post-test	90.0% (n=27)	10.0% (n=3)	0% (n=0)
		z-value	-4.690	2.333	3.783
		p-value	<0.001*	0.020*	<0.001*
B	Breathiness	Pre-test	60.0% (n=18)	40.0% (n=12)	0% (n=0)
		Post-test	63.3% (n=19)	36.7% (n=11)	0% (n=0)
		z-value	-0.302	0.302	-
		p-value	0.763	0.763	-
A	Asthenia	Pre-test	23.3% (n=7)	76.7% (n=23)	0% (n=0)
		Post-test	96.7% (n=29)	3.3% (n=1)	0% (n=0)
		z-value	-4.690	4.690	-
		p-value	<0.001*	<0.001*	-
S	Strain	Pre-test	10.0% (n=3)	90.0% (n=27)	0% (n=0)
		Post-test	80.0% (n=24)	20.0% (n=6)	0% (n=0)
		z-value	-4.583	4.583	-
		p-value	<0.001*	<0.001*	-
I	Instability	Pre-test	46.7% (n=14)	53.3% (n=16)	0% (n=0)
		Post-test	96.7% (n=29)	3.3% (n=1)	0% (n=0)
		z-value	-3.873	3.873	-
		p-value	<0.001*	<0.001*	-

*Significant difference: $p < 0.05$

In Table 1.2, McNemar's tests were used to determine whether the frequencies differed statistically significantly [$p < 0.05$] from each other between the categories of "Normal", "Slight", and "Moderate". For the "Normal" and "Slight" categories, all differences between pre- and post-test were significant, except for B [Breathiness], which only decreased marginally [3%, $n = 1$] in the "Slight" category and increased equally [3%, $n = 1$] in the "Normal" category. For the "Moderate" category, R [Roughness] differed significantly between pre- and post-test. The largest differences seen were a decrease of slight G [Grade of Hoarseness] [76.7%, $n=23$] and an increase of normality of G [76.7%, $n=23$ and R [73.7%, $n=22$] at post-test.

Table 1.3. Acoustic Parameter Outcomes and Pre-test -Post-test Comparisons (n=30)

Acoustic Parameters	Pre-test		Post-test		Significance
	<i>M</i> (SD)	<i>Mdn</i> (IQR)	<i>M</i> (SD)	<i>Mdn</i> (IQR)	<i>z</i> -value (<i>p</i> -value)
Jitter%	1.16 (0.56)	1.15 (0.68)	0.83 (0.38)	0.67 (0.64)	-2.653 (0.008*)
Shimmer%	3.67 (1.77)	3.21 (3.51)	4.30 (1.88)	3.40 (3.33)	-1.615 (0.106)
F0 (Hz)	1.32 (0.52)	1.10 (0.62)	1.36 (0.73)	1.22 (0.54)	-0.37 (0.711)
MPT /a/ (sec)	13.63 (4.03)	12.00 (4.00)	18.03 (4.24)	16.00 (7.25)	-3.991 (0.000*)
MPT /s/ (sec)	20.23 (6.17)	19.50 (4.50)	23.53 (7.19)	27.00 (15.00)	-1.957 (0.050*)
MPT /z/ (sec)	17.46 (5.19)	16.50 (6.25)	21.66 (6.11)	20.00 (10.75)	-3.151 (0.002*)
Harmonics -to-noise Ratio (dB)	0.13 (0.05)	0.13 (0.06)	0.15 (0.07)	0.15 (0.06)	-1.44 (0.150)
S/Z Ratio	1.21 (1.33)	1.13 (0.42)	1.12 (1.36)	1.10 (1.42)	-0.919 (0.358)
Frequency (Hz) Max	633.63 (172.46)	587.33 (257.11)	839.53 (220.72)	848.93 (268.41)	-3.579 (0.000*)
Frequency (Hz) Min	148.62 (29.76)	160.18 (37.95)	146.24 (30.77)	139.99 (24.94)	-0.342 (0.733)
Intensity (dB) Max	108.80 (24.56)	105.00 (11.00)	114.46 (29.27)	106.50 (19.25)	-0.769 (0.442)
Intensity (dB) Min	76.13 (8.13)	75.00 (16.00)	64.80 (5.49)	64.50 (5.50)	-4.055 (0.000*)
F0 (Hz) Max	516.15 (241.08)	493.88 (436.83)	665.57 (274.32)	678.86 (460.63)	-2.368 (0.018*)
F0 (Hz) Min	237.94 (112.01)	196.00 (106.69)	229.61 (200.71)	196.00 (138.59)	-1.594 (0.111)
DSI	-3.43 (2.91)	-3.70 (5.25)	1.57 (2.19)	1.90 (2.67)	-4.433 (0.000*)

*Significant difference: $p < 0.05$

Table 1.3 summarizes whether there were significant differences [$p < 0.05$] between pre- and post-test acoustic outcomes determined by the Wilcoxon signed-rank tests. Amongst the significant decreases seen in Jitter% and Intensity [dB] Min and the significant increases seen in MPT /a/, MPT /s/, MPT /z/, Frequency [Hz] Max, F_0 [Hz] Max, the largest *M* differences seen were the decrease of Intensity [dB] Min [11.33] and the increase of Frequency [Hz] Max [205.90] and F_0 [Hz] Max [149.42].

Table 1.4. Outcomes and Comparisons for Individual Factors on the VFI (n=30)

VFI Factors	Pre-test		Post-test		Significance
	<i>M</i>	<i>MDN</i> (IQR)	<i>M</i>	<i>MDN</i> (IQR)	<i>z</i> -value

	(SD)		(SD)		(p-value)
Factor 1. Tiredness of voice	34.10 (7.42)	35.50 (7.75)	15.43 (5.41)	14.50 (9.00)	-4.788 (0.000*)
Factor 2. Physical discomfort	14.30 (3.78)	15.00 (6.50)	3.233 (2.38)	3.00 (4.00)	-4.791 (0.000*)
Factor 3. Improvement of symptoms with rest	11.30 (1.48)	12.00 (1.00)	11.30 (1.14)	12.00 (2.00)	-0.079 (0.937)

*Significant difference: $p < 0.05$

When comparing the change between pre- and post-test Vocal Fatigue Index outcomes [Table 1.4] using the Wilcoxon signed-rank tests, a significant difference [$p < 0.05$] was seen with an average decrease to 15.43 [$Mdn = 14.50$, $SD = 5.41$, $IQR = 9.00$] for VFI Factor 1 [Tiredness of voice], 3.23 [$Mdn = 3.00$, $SD = 2.38$, $IQR = 4.00$] for VFI Factor 2 [Physical discomfort] at post-test.

1.5 Discussion/Conclusion

The results of the study reveal that OVUs are faced with multiple risk factors for vocal pathology and subsequent voice disorders due to prevalent medical, voice-use and emotional characteristics within this population. Furthermore, most of the participants [73.3%] reported suffering from GERD. Refluxate directly irritates the laryngeal mucosa through overflowing into the supraglottic space [36]. This causes tissue oedema, which is responsible for most laryngopharyngeal reflux symptoms as well as the resulting vocal symptoms seen. It is important to consider the diagnosis of GERD when treating OVUs, as 50% of patients with voice disorders also present with a form of reflux and their understanding of the disorder will greatly improve subsequent voice treatment [36,37].

A majority [90.0%, $n = 27$] of participants reported using their voice 8 hours a day for occupational reasons. This is similar to many previous studies where various OVUs reported high daily vocal demands [13,38–45] Literature shows that OVUs are likely to engage in prolonged and continuous voice use with only occasional periods of voice rest, loud and effortful talking [2,3,31,46].

Other than high voice demands, research suggests several commonly occurring risk factors that impact on the vocal health of OVUs [2,3]. These factors include various ergonomic and individual risk factors such as: lengthy duration of voice use; yelling over distances; poor room acoustics; poor posture; background noise; poor quality of

air; irritants; frequent habitual throat-clearing; lack of vocal health awareness; increased stress; anxiety and workload demands [2,3,12,36]. All of the participants [100.0%; n = 30] reported using their voice in less than optimal [noisy and dusty] environments as well as singing often. Literature has shown that environmental factors such as poor acoustic environments, high levels of background noise, poor atmospheric humidity, exposure to environmental irritants, raising your voice due to not having access to amplification systems, and inadequate VHE can also increase the risk of vocal trauma seen in OVUs [2,6,14,15,19,47]. Participants reported that they engage in vocally harmful or strenuous activities such as singing for extended periods of time [100%] and often clearing their throat [96.7%,n=29]. Vocal abuse and misuse patterns are commonly noticed in OVUs [2,3,36,40]. Thus, improper vocal behaviours and compounding risk factors may cause variations in vocal quality, reduced vocal range, and limited flexibility in voice and, occasionally, inflammation of the vocal folds that subsequently result in vocal fold pathology.

With regard to emotional characteristics of OVUs, all of the participants [100.0%;n=30] reported bodily signs of tension and almost all of the participants [96.7%; n = 29] reported a stressful work or home environment, understanding the connection between voice and psychological factors. Just over three-quarters [76.7%; n = 23] reported experiencing a stressed emotional state. Previous studies have revealed stress is considered a contributing factor to voice disorders within the OVU. Under stressful work conditions, the precision of vocal fold movement may be directly altered by the state of mind and emotions of the OVU [3]. This notion is supported by the decrease seen *average* DSI scores at post-test [-3.43 to 1.57] in correlation to the decreased levels of stressed emotional state [from 90.0%, n=27 to 76.7%, n=23] reported after the implementation of the VUR programme amongst participants. It can therefore be suggested that improved vocal quality and reduced vocal fatigue due to VUR may have influenced the levels of stress OVUs experienced.

It is central to the findings that all [100%; n = 30.0] of the participants reported that their voice symptoms improved with rest. Voice rest is often a first-line empiric treatment for phonotrauma [25]. Yet, literature reviews show the absence of an existing standard protocol for voice rest that can be applied in voice therapy [22,48]. Through the findings presented, it can be seen that the implementation of eight weeks of moderate to low VUR not only significantly improved perceptual voice quality and therefore reduced the

degree of voice disorder present [hoarseness, roughness, asthenia, strain and instability of the voice], but also the enhanced acoustic characteristics of voice by significant [$p < 0.05$] decreases in *Jitter* %, Intensity [dB] Min and DSI scores and significant [$p < 0.05$] increases MPT /a/, /s/ and /z/, Frequency [Hz] Max, and F_0 [Hz] Max as well as overall reduction of VF in OVUs.

When perceived in a voice, the GRBASI perceptual characteristics are all indicative of dysphonia, and, more specifically, the degree of voice disorder present. The perceptual differences observed between the pre- and post-test [GRBASI 4-point rating scale] revealed a significant [$p < 0.001$] decrease in slight G, R, A, S and I as well as moderate and slight R. Perceptual normality in all of these areas also increased significantly [$p < 0.001$] at post-test indicating significant improvement of perceptual voice quality overall. B was the only area that did not present with a significant difference; however, a decreased for slight B and increased normality of B perceived, indicated a positive yet insignificant effect after VUR.

When comparing acoustic outcome differences, post-test results indicated a significant improvement in parameters of voice quality. A reduction seen in *Jitter* % results in a voice with decreased roughness, associated with pathological voice [inflammation, nodules, polyps and weakness of the laryngeal musculature] and dysphonia [49]. The decrease seen in roughness due to *Jitter*% reduction correlates to the reduction in roughness of voice perceived in the perceptual outcomes. Thus, the decrease seen in *Jitter* % may possibly be due to the improved condition of the vocal folds following VUR. Enhanced vocal health is also indicated in a reduction of the Intensity Min [dB] as dysphonic patients were previously found to have increased minimum vocal intensity when compared to healthy voice controls [50]. After implementation of the VUR programme, participants were able to produce voice at significantly lower Intensity Min [dB] and therefore, presented with a larger range of Intensity [dB]. Overall dysphonia levels amongst participants decreased significantly by the reduction seen in DSI scores. The VUR programme thus resulted in a decrease in voice disorders present in participants. Increased MPT indicates that participants presented with better glottal control, efficiency and levels of coordination of breathing and phonation [51]. Thus, improved vocal endurance was seen after VUR. Higher Frequency [Hz] Max and F_0 [Hz] Max indicates that participants were able to reach significantly higher frequencies than before and therefore presented with a larger vocal range of frequency

after VUR. Although some differences revealed were not significant [$p < 0.05$], an increase in *Shimmer* %, F_0 , and Intensity [dB] Max and a decrease in S/Z Ratio, Frequency [Hz] Min, and F_0 [Hz] Min was observed at post-test, again collating the positive effect of the VUR programme on voice quality alongside the perceptual results.

VFI outcomes after VUR revealed a significant decrease in the areas of tiredness of voice and physical discomfort at post-test. This indicates that the VUR programme positively altered OVUs' perception of the level of VF they experienced in the areas of tiredness of voice and physical discomfort. VF has previously been defined by its clinical symptoms. Those symptoms include; increased vocal effort and discomfort, reduced pitch range and flexibility, reduced vocal projection or power, reduced control of voice quality, an increase in symptoms across the speaking day, and improvement of these symptoms after resting [52]. It can therefore be deduced that the aforementioned symptoms will improve through the use of VUR and its ameliorating effect on perceived VF [seen in Factors 1 and 2]. Improvement of symptoms with rest [Factor 3] remained unchanged before and after VUR merely due to participants consecutively scoring this section high at pre-test as well as at post-test. This reinforces the notion that OVUs strongly perceive improvement of VF symptoms with rest regardless of the current level of VF they are experiencing. Thus, the hypothesis was accepted that OVUs have a significant improvement in vocal quality and vocal fatigue outcomes through the use of the VUR programme.

1.5.1 Limitations and recommendations

There are potential limitations to the current study, which warrant mention. The sample included in this study was a group of mostly young [average age 27.4 [$SD = 8.7$]], vocally healthy OVUs. It may be that age and vocal health influence knowledge and perceptions reported, and it is therefore recommended that future research should be conducted on a sample with greater age variation. It may also, however, be advantageous that the cohort was younger as the findings emphasize the importance and need for early intervention in this population. Future studies could benefit from more objective measures in order to measure adherence to the VUR program and tracking of voice-use units used by participants. It is recommended that future research studies consider a broader variety of occupational groups that may benefit from the results and focus on profession specific outcomes or on specific categories of OVUs

[11], as this study used a diverse group of OVUs. Future studies should also explore if any of the risk factors might explain presenting symptoms (e.g., prevalence of reflux and symptoms of throat clearing). Due to this study being the first to explore the effects of the VUR programme on voice quality and vocal fatigue, it is recommended that future studies are larger scaled, experimental in design and continue to investigate how the VUR programme may affect vocal pathology, vocal quality and vocal fatigue in order to collect more evidence on which practice and treatment methods can be based.

1.5.2 Conclusion

The numerous risk factors OVUs face make them vulnerable to altered voice quality and vocal fatigue. When OVUs are left unable to perform their daily occupational tasks due to voice changes and VF this detrimentally affects their psychological well-being, professional lives and, ultimately, quality of life [2,7]. The insights gathered in this study have found that the use of a structured behaviour modification approach to VUR, such as the VUR programme [21], significantly reduced the degree of voice disorder and dysphonia seen in OVUs as seen in perceptual and acoustic outcomes. The noteworthy enhancement of voice quality, possibly due to the improved condition and health of the vocal folds, is evident in acoustic and perceptual results. Overall VF was also significantly improved and the prevailing sentiment appears to be that OVUs strongly perceive improvement of VF symptoms with rest regardless of the current level of VF they are experiencing. The VUR programme also decreased levels of stressed emotional state OVUs experience. When approaching OVUs, clinicians are encouraged to make use of a combination of direct voice therapy and vocal hygiene accompanied by the use of a sustainable programme, such as the VUR to help develop healthier use of the voice, foster patient autonomy, facilitate healing and prevent further/future injury. Voice rest has been proposed to 'decondition the voice' where voice therapy is thought to 're-condition the voice' [25] and, therefore should be used congruently. These findings serve to promote vocal health consciousness and awareness for preventive voice care initiatives in this unique population, through the use of VUR and the VUR programme.

1.6 Statement of Ethics

IRB approval was obtained for this study before data collection procedures commenced [HUM019/0321]. Research participants have given their written informed consent and that the study protocol was approved by the institute's committee on human research.

1.7 Conflict of Interest Statement

The authors have no conflicts of interest to declare.

1.8 Funding Sources

The University of Pretoria.

1.9 Author Contributions

Rouxjeanne Vermeulen was the main researcher and author. Maria du Toit, Kristiane van Lierde, Marien Alet Graham and Jeannie van der Linde were all co-authors.

1.10 Data Availability Statement

Data will be stored electronically for 15 years in the UP-data repository.

1.11 References

As mentioned in former references lists within this thesis as well as the following:

1. Devadas U, Hegde M, Maruthy S. Prevalence of and Risk Factors for Self-reported Voice Problems Among Hindu Temple Priests. *J Voice*. 2019;33[5]:805.e1-805.e12. doi:10.1016/j.jvoice.2018.03.020
2. Warhurst S, Madill C, McCabe P, Heard R, Yiu E, Wales NS. The Vocal Clarity of Female Speech-Language Pathology Students: An Exploratory Study. *J Voice*. 2012;26[1]:63-68. doi:10.1016/j.jvoice.2010.10.008
3. Santana ÉR, Lúcia M, Masson V, Araújo TM, Freitas L De. The Effect of Surface Hydration on Teachers' Voice Quality: An Intervention Study. *J Voice*. 2017;31[3]:383.e5-383.e11. doi:10.1016/j.jvoice.2016.08.019
4. Williams, Nerys & Carding P. *Occupational Voice Loss*. 1 edition. Boca Raton, FL: Taylor & Francis; 2005.

LEARNING OUTCOMES

As a result of this activity/article, the participant will be able to list the pertinent risk factors OVUs are faced with on a daily basis.

As a result of this activity/article, the participant will be able to describe the rationale of The VUR programme.

As a result of this activity/article, the participant will be able to assess the importance of including a modified voice rest/ voice conservation programme, such as the VUR, in therapy based on acoustic and perceptual outcomes found in OVUs.

CHAPTER 6

DISCUSSION, CLINICAL IMPLICATIONS AND CONCLUSION

6.1 Summary of research findings

A tiered investigative approach was employed to achieve the main aim of the project. The main aim of the research project was to understand and improve vocal health through a tiered investigation of vocal hygiene education, vocal demands, perceptions, knowledge, and voice use reduction in occupational voice users. The ICF Framework (WHO, 2001) was used as a guide and rationale while investigating all factors that influence voice related quality of life.

Study 1 revealed that 23 recent peer-reviewed, scientific articles demonstrate mixed results on the effect of VHE on vocal quality in PVUs. Measures of auditory perception, acoustic analysis, and self-rating found that the positive effects of VHE training in PVUs (Nusseck et al., 2019; Rodero et al., 2018). These included increased awareness of vocal hygiene and knowledge of the vocal mechanism, better-sustained voice quality across a vocal loading task, improved DSI scores, better mental health, increased perceptual voice quality values as well as enhancement of associated vocal and prosodic features [such as breathing, articulation, loudness, pitch, jitter, speech rate, pauses, and stress] (Nusseck et al., 2019; Rodero et al., 2018). Some studies observed the lasting effects of VHE maintained in PVUs after training had ceased, emphasising the importance of VHE as a long-term investment for voice-related healthy working life (Bolbol et al., 2017; Nusseck et al., 2019). The research reviewed suggests that increasing awareness about occupational vocal hygiene will help to improve PVUs' voice-related quality of work and to minimize any permanent vocal disability and/or impairments (Bolbol et al., 2017). Many studies highlighted the need for regular vocal training and VHE in PVUs as well as the negative effects on vocal outcomes when lacking (Aiken & Rumbach, 2018; Coelho et al., 2020; Cruz et al., 2019; Neto & Meyer, 2017). This lack of VHE is directly linked to the prevalence of self-reported acute and chronic voice symptoms and a greater perception of voice

handicap among PVUs (Aiken & Rumbach, 2018; Coelho et al., 2020; Cruz et al., 2019; Neto & Meyer, 2017). Yet, the positive outcomes presented are compelling enough to warrant implementing VHE programs for PVUs in combination with various direct voice training or therapy. These insights on VHE formed the first tier of the research project, informing us of the effectiveness and context in which VHE should be used. When used correctly VHE practices have been seen to aid in the remediation of the possible activity limitations and participation restrictions experienced by OVUs due to voice disorders or vocal symptoms (WHO, 2001). A combination of direct voice treatment and VHE should be used for optimal outcomes as PVUs and future PVUs with and without voice disorders have elevated risk for dysphonia and voice disorders that are not effectively addressed through common vocal hygiene recommendations alone (Achey et al., 2016; Liu et al., 2020; Nallamuthu et al., 2021; Rangarathnam et al., 2018; Rodríguez-Parra et al., 2011). This insight laid the foundation for the first tier of the investigation.

Study 2, the second tier of the research project, aimed to identify the activity limitations and participation restrictions experienced by OVUs based on their self-reported demands, perceptions, and knowledge, compounded by further environmental and personal factors (WHO, 2001). Study two found that high daily vocal demands (8 hours a day) can be linked to VF, changes in voice quality, and vocal symptoms experienced. High vocal demands are significantly correlated to an increase in perceived vocal handicap $rs=0,242$; ($p=0,018$), tiredness of voice $rs=0,270$; ($p=0,008$), and physical discomfort $rs=0,217$; ($p=0,038$), as well as how OVUs experience improvement of symptoms with rest $rs= -0,356$; ($p<0,001$). It is essential that OVUs, and treating clinicians, are aware of certain significant predictors of both vocal handicap and VF. GERD ($= 3.221$, $p=0.005$), roughness of voice ($= 5.100$, $p<0.001$), and VF ($= 3.267$, $p=0.036$), have been identified as significant predictors of vocal handicap. Roughness of voice ($= 5.016$, $p=0.004$), hoarseness of voice ($= 5.272$, $p<0.006$), and smoking ($= 4.031$, $p=0.032$) are significant predictors of tiredness of voice whereas roughness of voice ($= 1.886$, $p=0.016$), allergies ($= 1.695$, $p<0.017$), and VF ($= 2.333$, $p=0.020$) significantly predict physical vocal discomfort. Although many OVUs report that they have previously received VHE, almost half report that this training was insufficient. Other risk factors highlighted in OVUs that form part of the cumulative environmental and personal factors described by the ICF framework are; the ingestion of liquid

caffeine, alcohol, and carbonated drinks, smoking or the presence of chronic cough, chronic laryngitis and GERD (Franca & Wagner, 2015; WHO, 2001).

By establishing the limitations and restrictions (WHO, 2001) OVUs face due to persisting daily vocal demands that lead to voice disorders in tier 2, tier 3 could now conceptualise an innovative way to approach the prevention and treatment thereof. The insights gathered in study 3 found that the use of a structured behaviour modification approach to VUR, such as the VUR programme (Van Der Merwe, 2004), significantly reduced the degree of voice disorder and dysphonia seen in OVUs. The noteworthy enhancement of voice quality, possibly due to the improved condition and health of the vocal folds, is evident in acoustic and perceptual results. Overall VF was also significantly less (Tiredness of voice -4.788 (0.000*) and physical discomfort-4.791 (0.000*)) and the prevailing sentiment appears to be that OVUs strongly perceive improvement of VF symptoms with rest regardless of the current level of VF they are experiencing. The VUR programme also decreased levels of stressed emotional state OVUs experience. This alludes to the VUR program assisting in the prevention and treatment of voice disorders on a multidimensional level, as proposed by the ICF framework (WHO, 2001). Body functions and structures are addressed through enhanced health of the vocal folds. Activity limitations and participation restrictions are lessened as a direct result of this and this in turn positively impacts the OVU's emotional well-being and overall quality of life.

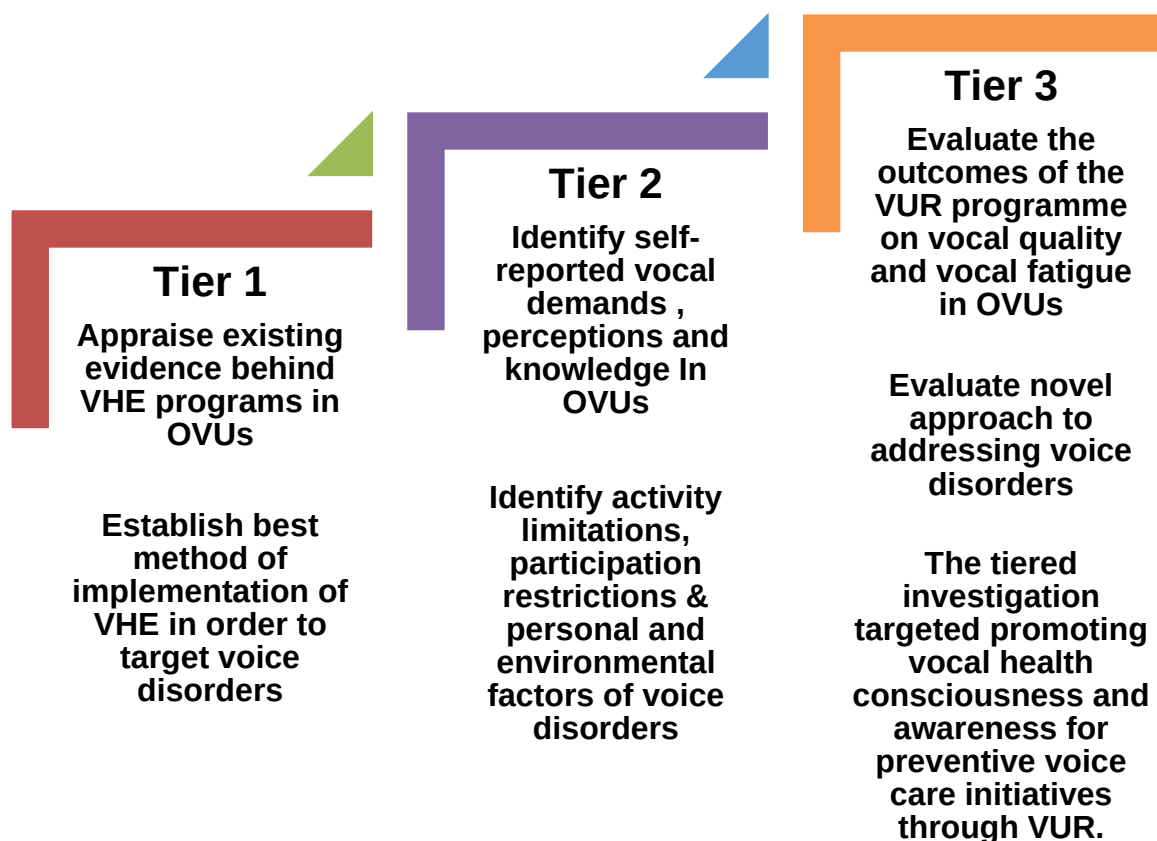


Figure 6.1-Tiered approach to research project and relation to ICF Framework as rationale for the research project

6.2 Clinical and theoretical implications

The numerous ergonomic and individual risk factors OVUs face, such as: lengthy duration of voice use; yelling over distances; poor room acoustics; poor posture; background noise; poor quality of air; irritants; frequent habitual throat-clearing; lack of vocal health awareness; increased stress; anxiety and workload demands (Devadas et al., 2019; Rangarathnam et al., 2018; Wingate et al., 2007) make them vulnerable to altered voice quality and increased VF. When OVUs are left unable to perform their daily occupational tasks due to voice changes and VF, this can detrimentally affect their psychological well-being, professional lives, and, ultimately, quality of life (Pomaville et al., 2019). Therefore, a structured VHE programme guiding voice rest/reduction, such as the VUR programme implemented by speech-language

pathologists in clinical practice, could be very valuable. Studies one and two both indicated that low awareness of vocal hygiene or insufficient vocal hygiene education is linked to self-reported acute and chronic vocal symptoms as well as a greater perception of voice handicap and vocal fatigue amongst OVUs. Clinicians should be aware of the importance of VHE in how educating and information counselling is a vital part of the therapy process in order to avoid the predictive factors of vocal handicap and vocal fatigue identified. Risk factors highlighted in OVUs are the ingestion of liquid caffeine, alcohol, and carbonated drinks, smoking or the presence of chronic cough, chronic laryngitis, and GERD. These findings provide insight for developing practical strategies for training and cultivating vocal health consciousness and preventive voice care initiatives that focus on OVUs in South Africa.

The value of screening OVUs via questionnaires and surveys as a method of surveillance may be valuable, as many OVUs do not actively seek out medical or therapeutic services or underestimate their voice problem/symptoms. Self-reported vocal complaints and symptoms serve as a direct method of identifying imminent voice disorders due to cumulative vocal fatigue within this population. Preventative surveillance through regular screening in OVUs' places of employment may provide important information on OVUs' vocal profiles over a longitudinal period. This will ensure that appropriate preventative early intervention recommendations and approaches, such as the VUR programme, can be implemented timeously in order to readily address concerns as they arise. This research project indicates that VHE should be incorporated in therapeutic or rehabilitative voice programs for OVUs in combination with various direct voice training or therapy. Additionally, it is emphasised that VHE should be viewed as not only part of the treatment approach when an existing voice disorder is identified but also as a prevention tool to be implemented by the OVU in daily life. The importance of an early diagnosis or detection of changes in vocal function in this group must not be underestimated.

The importance and advantages of viewing voice disorders holistically (bodily functions and structures and emotions affecting activity and participation) will remain a key factor in the development of appropriate prevention and rehabilitation programmes. This was highlighted in study three where the VUR programme was seen to decrease levels of stressed emotional state that some OVUs experience.

Clinicians and researchers must be cognisant that not only organic and voice use factors affect the vocal quality in OVUs, but also the emotional and psychological factors they experience. Studies one and two highlighted that factors that influence voice quality are similar across the globe (Buckley et al., 2014; Büyükatalay et al., 2020; Franca, 2012; Franca & Wagner, 2013; Hapner & Gilman, 2011; Munier & Farrell, 2016; Gunasekaran et al., 2015). No matter the socio-economic context, OVUs are still faced with equally high vocal demands that are accompanied by VF and vocal symptoms and a reported lack of VHE. The challenges that the OVUs all over the world face, make them more susceptible to vocal risks that may cause altered laryngeal function, inability to perform their occupational activities, and in severe cases, contribute to vocal problems that may affect their psychological well-being and professional lives (Buckley et al., 2014; Büyükatalay et al., 2020; Franca, 2012; Franca & Wagner, 2013; Hapner & Gilman, 2011; Munier & Farrell, 2016; Gunasekaran et al., 2015).

The empirical findings of this project can be used to expand on existing therapy protocols and the inclusion of VHE, more specifically VUR, in OVUs and other populations at-risk of functional voice disorders. Findings can inform authors writing standard protocols for governing associations that guide practice and practitioners in South Africa, such as the Health Professions Council of South Africa (HPCSA) and the South African Speech-Language and Hearing Association (SASLHA). If the value of VUR in VH can be seen as an essential part of a clinical approach to voice disorders and incorporated as part of standard voice therapy protocols, it could effectively serve clients that are considered vulnerable and at risk of developing voice disorders, such as OVUs. Research findings from this project may have implications for future undergraduate training of speech-language therapists, vocal coaches, and voice pedagogues, since findings highlight the importance of adding the importance of VHE encompassing VUR into standard treatment approaches to the wide range of voice disorders encountered in practice.

6.4 Study strengths and limitations

Study strengths

The systematic review consisted of 23 studies that encompassed multiple levels of OVUs making the findings widely applicable to the general OVU population. This project is the first of its kind to implement the VUR programme in order to determine the effects on voice quality and vocal fatigue outcomes. The findings from this research project indicate the potential of VUR as a standard approach to functional voice disorders within the therapeutic context. Furthermore, the project revealed the comprehensive voice profiles of OVUs and how they are similar to the voice profiles of OVUs globally. The nature of the project allowed for timely and accurate referrals to be made to relevant healthcare professionals and speech therapists, as all participants received a comprehensive voice assessment. Additionally, this project contributes to the body of knowledge advocating for and highlighting the importance of VHE in OVUs and the current lack thereof.

Various methodological strengths can be highlighted. Firstly, various types of research designs were used to achieve the main aim of this research project. The prospective designs and tools used in all three of the research studies contributed to the reliability and validity of the findings. All data were collected by a single researcher, a qualified and experienced speech-language therapist with experience in voice intervention and assessment, which contributed to the reliability of the findings.

Study limitations

The population sample used for this research project included a group of mostly young (average age 27.4 ($SD = 8.7$)), vocally healthy OVUs from five occupational groups (teachers, lecturers, singers, performers, and call centre agents). The findings are thus not representative of the South African OVU population. Geographic and demographic representation was also poor, as all participants were from Tshwane. It may be that age and vocal health influence the knowledge and perceptions reported. It may, however, be advantageous that the cohort was younger as the findings emphasize the importance and need for early intervention in this population.

The limitations of study one included possible language bias as only articles written in English or translated into English were included leading to the possible omission of some studies. Although the VHE programmes utilised in the studies selected are based on the same principles, the programmes varied, which may have affected the study outcomes. In study 2 it would have been beneficial to the findings if the perceptions, demands and demands of South African OVUs were compared to that of other countries. It would have also been advantageous if study three was conducted on a larger scale and experimental in design, with a control group, in order to compare outcomes in this cohort. It would have also been beneficial if the gender composition and effect thereof on voicing was accounted for in studies 2 and 3. Future research can build upon the evidence that this research project has compiled.

6.5 Recommendations for future research

This research study formed the basis of knowledge on vocal hygiene education, vocal demands, perceptions knowledge, and voice use reduction in occupational voice users. Future research should aim to identify optimal combinations of direct and indirect (VHE) treatment approaches for OVUs, and the unique challenges they face regarding occupational voice demands. A future meta-analysis on the effect of VHE on various voice parameters should be explored. Future research from LMICs is essential as divergent contextual factors will influence vocal treatment approaches and therapy outcomes. It is recommended that future research should be conducted on a sample with greater age variation and consider a wider variety of occupational groups that may benefit from the results and focus on profession-specific outcomes or on specific categories of OVUs (Koufman & Isaacson, 1991). Due to this study being the first to explore the effects of the VUR programme on voice quality and vocal fatigue, it is recommended that future studies are larger scaled, experimental in design, and continue to investigate how the VUR programme may affect vocal pathology, vocal quality, and vocal fatigue in order to collect more evidence on which practice and treatment methods can be based. It can also be considered to include other means of acoustic analysis methods such as cepstral analysis.

6.6 Conclusion

The most significant contribution of the project may be that it provides the first known comprehensive description of the outcomes of the VUR Programme on voice quality and vocal fatigue. A novel description of the voice profile of OVUs requiring voice rehabilitation is introduced. The study adds to the knowledge base of all speech-language therapists, not only in South Africa and those from LMICs, as literature has shown voice profiles and symptoms of OVUs to be similar regardless of demographic area or income status.

When approaching OVUs, clinicians are encouraged to make use of a combination of direct voice therapy and vocal hygiene accompanied by the use of sustainable programmes, such as the VUR, to help develop healthier use of the voice, foster patient autonomy, facilitate healing, and prevent further/future injury. Voice rest has been proposed to decondition the voice whereas voice therapy is thought to recondition the voice (Haben, 2012) and, should therefore be used congruently. These findings serve to promote vocal health consciousness and awareness for preventive voice care initiatives in this unique population, through the use of VHE and the VUR programme.

REFERENCES

As mentioned in former references lists within this thesis.

APPENDICES

Appendix A: Example of Invitational letters to employers (Advance Call Centre, Maragon Mooikloof High School, Bambolini Nursery School) and Heads of departments For BMus Singing and BDrama and program coordinators



Faculty of Humanities

Fakulteit Geesteswetenskappe
Lefapha la Bomotha



April 2021

Philippus Fouche
CEO
Advance Call

Dear Mr Fouche

PERMISSION TO INCLUDE CALL CENTRE AGENTS AT ADVANCE CALL AS PART OF A DOCTORATE RESEARCH PROJECT.

Study titles:

1. Reported vocal demands in professional voice users: An exploratory study
2. The effect of the VUR programme on professional voice users in South Africa

Introduction:

As a Speech-Language Pathology doctoral candidate, I am required to conduct a research project. My project is within the field of Voice. As part of the scope of practice of speech-language therapists, our role includes prevention, assessment and the treatment of voice disorders.

The aim of the study:

This study aims to contribute to the body of research in the field of Speech-Language Pathology and more specifically Voice in professional voice users (PVUs). Due to the voice being an occupational instrument, a PVUs professional and vocational success relies heavily on optimal voice quality. Many time PVUs such as call centre agents teachers and lecturers lack vocal health/hygiene education ,and the role of voice reduction/rest can be overlooked. Research will be conducted that evaluates the vocal demands and the effect of the Voice Use Reduction (VUR) Programme in PVUs.

Participants:

Call centre agents, lecturers, teachers and singers will be selected to participate in the study. Regrettably, participants with a current diagnosis of a voice disorder by an Ear-Nose and Throat Specialist cannot participate, as this will affect the data collected.

Ethical Approval:

The research is subject to ethical clearance from the Research and Ethics Committee of the Faculty of Humanities, as well as the permission of the Director of Student Affairs at the University of Pretoria.



Faculty of Humanities

Fakulteit Geesteswetenskappe
Lefapha la Bomotha



Risks involved in participating in this study:

Participation in this study will not involve any risk and is non-invasive.

Procedures:

Study 1

Upon written consent from participants, a case history questionnaire will be provided and completed to gather the participants' voice histories regarding age, level of voice training, general health (reflux and allergies), medical history, vocal habits (smoking, alcohol consumption, and vocal abuse) and voice use/load. Alongside the case history questionnaire, the participants will be asked to fill in surveys on the vocal demands they face as a PVU, the Vocal Fatigue Index (VFI) and the Voice Handicap Index (VHI-10). The informed consent form, case history questionnaire, VFI and VHI-10 will be sent via email correspondence and will not require face-to-face contact with participants.

Study 2

From the participants who will participate in study 1, some will then randomly be selected to participate in study 2. In study 2, participants will receive a comprehensive voice assessment in order to establish a baseline for vocal quality. Covid-19 regulation will be strictly adhered to at all times by wearing masks, social distancing and regular hand washing and sanitizing of all equipment used by researcher and participants. They will be asked to complete the Voice Use Reduction (VUR) programme daily for eight weeks (if no vocal fold pathology is detected). If vocal pathology is detected, then the VUR Programme may extend to 10 weeks. All of the participants' problematic vocal behaviours will be identified and specified in quantitative terms, quantifiable goals will be set, and the participant will then be guided on how to apply the programme. Progress will be monitored by both the participant and the researcher periodically. Participants will only be allowed to use a predetermined number of units per day and week. The programme is started at stage one: severe voice use reduction and gradually, as the voice improves, progresses to stage two: moderate voice use reduction and finally, ends in stage three: low voice use reduction. Duration of the stages is dependent on improvement of the condition of the vocal folds, vocal quality, vocal fatigue, vocal effort and laryngeal pain levels. When progressing through the levels of the VUR Programme, more voice use units will be allowed per day and week. Progress is tracked through the use of the VUR Programme graphs and perceptual and acoustic voice analysis. All assessments will be conducted by the researcher at the Voice Laboratory at the University of Pretoria.

The tests will not interfere with work hours and all participation will be voluntary. All of the data collected will be kept confidential and only the researcher and supervisors of the study will have access to the information. Data in this study will be stored on the University of Pretoria's databases and in hardcopy format in the Department of Speech-Language Pathology and Audiology for archiving and possible future research and teaching. Steps will be taken to protect the identity and personal information of the participants. I hope that my request for Advance Call, call centre agents as voluntary participants, will meet your approval.



Faculty of Humanities

Fakulteit Geesteswetenskappe
Lefapha la Bomotha



Yours Sincerely,



Mrs. Rouxjeanne Vermeulen
PhD Candidate



Prof J. Van Der Linde
Supervisor



Dr. M. Du Toit
Supervisor



Prof J. van der Linde
Head: Department of Speech-Language Pathology and Audiology



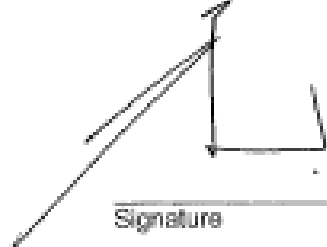
Faculty of Humanities

masulini Deemosebetelemphe
LeFaphe la Bantethe

Humanities 101
2020

PERMISSION BY CEO OF ADVANCE CALL TO CONDUCT RESEARCH

Philippe S Fouche, was informed about all the details pertaining to the study titled: *Reported vocal demands in professional voice users: An exploratory study* and *The effect of the VUR programme on professional voice users in South Africa*, and give permission to conduct the research with call centre agents from Advance Call.



Signature

12-04-2021
Date (dd/mm/yy)

Appendix B: Recruitment pamphlet

What is
Vocal
Hygiene
Education?

Am I
protecting
my voice?



Participate in my PhD study

What does participation entail?

Completing an online survey and being educated on how to best preserve and protect your voice as a professional voice user.

- Safeguarding your voice against a voice disorder
- Decreasing vocal misuse and abuse
- Adequate hydration
- Optimal voice production

Appendix C: Informed consent form



Faculty of Humanities

Fakulteit Geesteswetenskappe
Lefapha la Bomotheo



Department of Speech-Language Pathology and Audiology

January 2021

Dear Participant

PARTICIPATION IN A POSTGRADUATE RESEARCH PROJECT

Study titles:

- The effect of the VUR programme on professional voice users in South Africa.
- Self-reported contextual voice use vs an automated outcome: A comparative study.

Introduction:

As a speech-language pathology doctorate student, I am conducting a research project in the field of voice.

The aim of the study:

Due to the voice being an occupational instrument, professional voice users' (PVUs) vocational success relies heavily on optimal voice quality. The role of voice use reduction or modified voice rest is, however, overlooked at times. This research aims to evaluate an innovative eHealth approach to voice use reduction for PVUs, hereby contributing to the body of research in the field of Speech-Language Pathology, specifically voice in professional voice users.

Participants:

You are invited to participate in this research study that requires the participation of male and female PVUs between the ages of 18 and 32. To participate, you must be proficient in English. Regrettably, if you have a current diagnosis of a voice disorder made by an Ear-Nose and Throat Specialist or if you have previously received any voice therapy from a speech-language therapist you will not be able to participate as this will affect the data collected.

Procedures:

In this study, you will receive a comprehensive voice assessment after which you will be asked to wear a device that will detect your vocal fatigue. You will also be asked to complete the Voice Use Reduction (VUR) programme daily for eight weeks (if no vocal fold pathology is detected). All your problematic vocal behaviours will be identified and specified in quantitative terms, quantifiable goals will be set, and you will then be guided on how to apply the programme. Progress will be monitored by you and the researcher periodically. The VUR Programme allows for allocation of voice units to each situation depending on daily vocal demand. The more detrimental the effect, the more units will be assigned. As a participant, you will then only be allowed to use a predetermined number of units per day and week. The programme is started at stage one: severe voice use reduction and gradually, as the voice improves, progresses to stage two: moderate voice use reduction and finally, ends in stage three: low voice use reduction. Duration of the stages is dependent on improvement of the condition of the vocal folds, vocal quality, vocal fatigue, vocal effort and laryngeal pain levels. When progressing through the levels of the VUR Programme, more

Room 3-14, Communication Pathology Building
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa

Tel +27 (0)12 420 2355 | Fax +27 (0)12 420 2355
Email maria.dutoit@up.ac.za | www.up.ac.za/faculty-of-humanities

voice use units will be allowed per day and week. Progress is tracked using the VUR Programme graphs, laryngoscopic examinations and perceptual and acoustic voice analysis.

Ethical Approval:

The research is subject to ethical clearance from the Research and Ethics Committee of the Faculty of Humanities.

Risks involved in participating in this study:

No risks are involved in this study for participants.

Your rights as a participant in this study:

Your participation would purely be on a voluntary basis and if at any time, you wish to withdraw, you may do so without any negative consequences. All the data collected will be kept confidential and only the researcher and supervisors of the study will have access to the information. Data in this study will be stored on the University of Pretoria's databases and in hardcopy format in the Department of Speech-Language Pathology and Audiology for archiving and possible future research and teaching for a period of 15 years. Steps will be taken to protect your identity and personal information. Each participant will receive a participant number to maintain anonymity and no identifying information will be captured by the researcher. Results will be published or presented in a way participants remain unidentifiable.

Compensation and benefits:

Your participation is entirely voluntary and therefore participants will not be compensated. You may benefit from your participation in this research by learning how to better manage your daily and weekly voice use and through this optimize your voice quality and minimize your experience of vocal fatigue and ultimately prevent voice disorders.

Questions about the study can be directed to my academic supervisor, Prof J. van der Linde, at the Department of Speech-Language Pathology and Audiology via email:

jeannie.vanderlinde@up.ac.za

Your participation would highly be appreciated. If you wish to participate in this study, please complete the informed consent form and return it to the researcher.

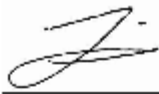
Yours sincerely,



Rouxjeanne Vermeulen
Student

Room 3-14, Communication Pathology Building
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa

Tel +27 (0)12 420 2355 | Fax +27 (0)12 420 2355
Email maria.dutoit@up.ac.za | www.up.ac.za/faculty-of-humanities



Prof J. Van Der Linde
Supervisor and HoD



Dr. M. Du Toit
Supervisor

Room 3-14, Communication Pathology Building
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa
Tel +27 (0)12 420 2355 | Fax +27 (0)12 420 2355
Email maria.dutoit@up.ac.za | www.up.ac.za/faculty-of-humanities

INFORMED CONSENT TO PARTICIPATE IN THIS STUDY

I have read or had read to me the above information before signing this consent form. The content and meaning of this information have been explained to me. I have been given opportunity to ask questions and am satisfied that they have been answered satisfactorily. I understand that if I do not participate it will not alter my management in any way. I hereby volunteer to take part in this study and grant permission for data obtained by my participation to be used in future research.

I have received a signed copy of this informed consent agreement.

Kelsey Day 14/03/2022

Participant name Date

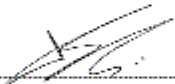


14/03/2022

Participant signature Date

Rouxjeanne Vermeulen 14/03/2022

Investigator's name Date



14/03/2022

Investigator's signature Date



14/03/2022

Witness name and signature Date

Room 3-14, Communication Pathology Building
 University of Pretoria, Private Bag X20
 Hatfield 0028, South Africa
 Tel +27 (0)12 420 2355 | Fax +27 (0)12 420 2355
 Email maria.dutoit@up.ac.za | www.up.ac.za/faculty-of-humanities

Appendix D: Vocal demands survey including The Voice Handicap Index (VHI-10) (Rosen et al., 2004), and The Vocal Fatigue Index (VFI) (Nanjundeswaran et al., 2015)

Qualtrics^{XM} Vocal Demands Survey

Start of Block: Personal Information

Q1 Age?

Q2 Date of Birth?

End of Block: Personal Information

Start of Block: Voice History



Q3 Do you have a voice disorder diagnosed by an ear-nose and throat specialist (ENT)?

No (1)

Yes (2)

Q4 If yes, have you received voice therapy?

No (1)

Yes (2)



Q5 Do you have allergies?

No (1)

Yes (2)

Q6 If yes, please specify?



Q7 Do you have a post nasal drip?

No (1)

Yes (2)



Q8 Do you have sinusitis?

No (1)

Yes (2)

Q9 Do you have any ear problems?

No (1)

Yes (2)

Q10 If yes, please specify?



Q11 Do you suffer from chronic colds?

No (1)

Yes (2)



Q12 Do you suffer from chronic laryngitis?

No (1)

Yes (2)

Q13 Do you suffer from esophageal reflux?

No (1)

Yes (2)

Q14 Do you suffer from chronic cough?

No (1)

Yes (2)



Q15 Have you ever been intubated?

No (1)

Yes (2)



Q16 Do you suffer from an endocrine illness or are you currently undergoing any hormonal treatments?

No (1)

Yes (2)

Q19 If yes, please specify?

Q17 Are you aware of any laryngeal injuries you have sustained?

No (1)

Yes (2)

Q20 If yes, please specify the extent of the injury and when it occurred?

Q18 Have you undergone any laryngeal procedures where anaesthetics were required?

No (1)

Yes (2)

Q21 If yes, please specify the procedure and when it occurred?

End of Block: Voice History

Start of Block: Medical History

Q22 Do you have any other voice related medical problems?

No (1)

Yes (2)

Q23 If yes, please specify?



Q24 Are you currently using any medication (Chronic, Acute, Self-medication)?

No (1)
Yes (2)

Q25 If yes, please specify what you are currently taking?

Q26 Are you currently on any form of birth control?

No (1)
Yes (2)

End of Block: Medical History

Start of Block: Dietary History

Q27 Do you ingest any of the following daily: Liquid caffeine (coffee, tea, energy drinks, soda etc.)

No (1)
Yes (2)

Q28 If yes, how many cups/units a day?



Q29 Other forms of caffeine (chocolates, energy bars etc.)?

No (1)
Yes (2)

Q30 If yes, how many servings a day?



Q31 Do you drink water?

No (1)
Yes (2)

Q32 If yes, how many glasses/mL a day?

Q33 Do you drink alcoholic beverages?

No (1)

Yes (2)

Q35 If yes, how many glasses/mL a day?



Q34 Do you drink carbonated drinks?

No (1)

Yes (2)

Q36 If yes, how many glasses/mL a day?



Q37 Do you ingest dairy products (milk, cheese, yogurt etc.)?

No (1)

Yes (2)

Q39 If yes, how many servings a day?



Q38 Do you smoke?

No (1)

Yes (2)

Q40 If yes, how many cigarettes a day?

End of Block: Dietary History

Start of Block: Voice Use

Q41 How often do you use your voice for work during a week?

8-16 hours (1-2 days) (1)

16-24 hours (2-3 days) (2)

32-40 hours (4-5 days) (3)

Q42 Specify how many hours in total per day?

Q43 What is the average duration of a voice use session at work?



Q44 Do you ever feel a change in voice quality before and after work?

No (1)

Yes (2)

Q45 If yes, mark all the appropriate symptom(s) you experience?

Breathiness (1)

Pain (2)

Hoarseness (3)

Roughness (4)

Generally softer voice (5)

Only softer on certain pitch (6)

Loss of voice (7)



Q46 Does your voice feel tired after a day of work or the following day?

No (1)

Yes (2)



Q47 Do you often attend events/environments where you are exposed to loud music/ loud noise?

No (1)

Yes (2)



Q48 Do you often attend events/environments where you are expected to shout/scream/cheer loudly?

No (1)

Yes (2)

Q78 Have you ever received voice/vocal training?

Yes (1)

No (2)

Q79 Have you ever received vocal health education on how to care for your voice?

No (1)

Yes (2)

Q80 If so, do you feel it was sufficient/enough?

Yes (1)

No (2)

End of Block: Voice Use

Start of Block: Voice Handicap Index (VHI-10) (Rosen,2004)

Q1 My voice makes it difficult for people to hear me.

Never (1)

Almost Never (2)

Sometimes (3)

Almost Always (4)

Always (5)

Q2 People have difficulty understanding me in a noisy room.

Never (1)

Almost Never (2)

Sometimes (3)

Almost Always (4)

Always (5)

Q3 My voice difficulties restrict my personal & social life.

Never (1)

Almost Never (2)

Sometimes (3)

Almost Always (4)

Always (5)

Q4 I feel left out of the conversations because of my voice.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q5 My voice problem causes me to lose income.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q6 I feel as though I have to strain to produce voice.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q7 The clarity of my voice is unpredictable.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q8 My voice problem upsets me.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q9 My voice makes me feel handicapped.

- Never (1)

Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q10 People ask, "What's wrong with your voice?"

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

End of Block: Voice Handicap Index (VHI-10) (Rosen,2004)

Start of Block: Vocal Fatigue Index (VFI) (Nanjundeswaran et al., 2015)

Q1 I don't feel like talking after a period of voice use.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q2 My voice feels tired when I talk more.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q3 I experience increased sense of effort with talking.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q4 My voice gets hoarse with voice use.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q5 It feels like work to use my voice.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q6 I tend to generally limit my talking after a period of voice use.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q7 I avoid social situations when I know I have to talk more.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q8 I feel I cannot talk to my family after a work day.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q9 It is effortful to produce my voice after a period of voice use.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q10 I find it difficult to project my voice with voice use.

- Never (1)
- Almost Never (2)

Sometimes (3)
Almost Always (4)
Always (5)

Q11 My voice feels weak after a period of voice use.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q12 I experience pain in the neck at the end of the day with voice use.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q13 I experience throat pain at the end of the day with voice use.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q14 My voice feels sore when I talk more.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q15 My throat aches with voice use.

Never (1)
Almost Never (2)
Sometimes (3)
Almost Always (4)
Always (5)

Q16 I experience discomfort in my neck with voice use.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q17 My voice feels better after I have rested.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q18 The effort to produce my voice decreases with rest.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

Q19 The hoarseness of my voice gets better with rest.

- Never (1)
- Almost Never (2)
- Sometimes (3)
- Almost Always (4)
- Always (5)

End of Block: Vocal Fatigue Index (VFI) (Nanjundeswaran et al., 2015)

Appendix E: The Rainbow Passage (Fairbanks, 1960).

The Rainbow Passage

When the sunlight strikes raindrops in the air, they act as a prism and form a rainbow. The rainbow is a division of white light into many beautiful colours. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow. Throughout the centuries, people have explained the rainbow in various ways. Some have accepted it as a miracle without physical explanation. To the Hebrews it was a token that there would be no more universal floods. The Greeks used to imagine that it was a sign from the gods to foretell war or heavy rain. The Norsemen considered the rainbow as a bridge over which the gods passed from earth to their home in the sky. Others have tried to explain the phenomenon physically. Aristotle thought that the rainbow was caused by reflection of the sun's rays by the rain. Since then, physicists have found that it is not reflection, but refraction by the raindrops, which causes the rainbows. Many complicated ideas about the rainbow have been formed. The difference in the rainbow depends considerably upon the size of the drops, and the width of the coloured band increases as the size of the drops increases. The actual primary rainbow observed is said to be the effect of super-imposition of a number of bows. If the red of the second bow falls upon the green of the first, the result is to give a bow with an abnormally wide yellow band, since red and green light when mixed form yellow. This is a very common type of bow, one showing mainly red and yellow, with little or no green or blue.

Appendix F: IRB approval obtained for all studies (HUM019/0321).



Faculty of Humanities

Fakulteit Geesteswetenskappe
Lefapha la Bomotho



19 October 2021

Dear Mrs R. Vermeulen

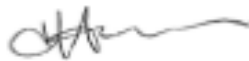
Project Title:	The effect of vocal hygiene and voice use reduction in professional voice users: An explorative study
Researcher:	Mrs R. Vermeulen
Supervisor(s):	Mrs MN du Toit Prof J Van der Linde
Department:	Speech Language Path and Aud
Reference number:	13206258 (HUMD19/0321)
Degree:	Doctoral

I have pleasure in informing you that the above application was approved by the Research Ethics Committee on 19 October 2021. Data collection may therefore commence.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. Should the actual research depart significantly from the proposed research, it will be necessary to apply for a new research approval and ethical clearance.

We wish you success with the project.

Sincerely,



Prof Karen Harris
Chair: Research Ethics Committee
Faculty of Humanities
UNIVERSITY OF PRETORIA
e-mail: tracey.andrew@up.ac.za

Research Ethics Committee Members: Prof K. Harris (Chair); Mr A. Bano; Dr A. M. de Beer; Dr A. dos Santos; Dr F. Gubara; Ms KT Gavender Andrew; Dr E. Johnson; Dr S. Krige; Prof D. Meyer; Mr A. Mohamed; Dr I. Nicol; Dr J. Ockle; Dr C. Pattergill; Prof D. Poykari; Prof M. Sear; Prof E. Toller; Ms D. Mokhele

Room 3-21, Humanities Building, University of Pretoria, Private Bag 600, Hatfield 0028, South Africa
Tel +27 (0)12 420-4652; Fax +27 (0)12 420-4600; email pg.humanities@up.ac.za | www.up.ac.za/faculty-of-humanities

Appendix G: Survey Committee approval obtained for Study 2.



Office of the Registrar

2021-09-09

Ms R Vermeulen
Department of Department of Speech-Language Pathology and
Audiology
Faculty of Humanities
University of Pretoria

Email: rouxjeannevermeulen@gmail.com

Dear Ms Vermeulen

APPROVAL OF RESEARCH STUDY

The UP Survey Coordinating Committee has granted approval for the research study titled "The effect of vocal hygiene and voice use reduction in professional voice users: An explorative study".

The proposed research study has to strictly adhere to the associated study protocol, as well as the UP Survey Policy and the Ethics Committee of the Faculty of Humanities instructions.

Please liaise with the Market Research Office in the Department of Institutional Planning (carlien.nell@up.ac.za) to officially register the study. In order to register the study, the Market Research Office has to receive the formal ethical approval letter from the Faculty of Humanities.

A final electronic copy of the research outcomes must be submitted to the Survey Coordinating Committee as soon as possible after the completion of the study.

Kind regards



Prof CMA Nicholson
REGISTRAR
CHAIRPERSON: SURVEY COORDINATING COMMITTEE

Rectorate, Room 4-23, 4th floor, Administration Building, Hatfield Campus
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa
Tel: +27 (0)12 420 4236
Fax: +27 (0)12 420 5849
Email: regis@up.ac.za
www.up.ac.za

Kantoor van die Registrateur
Ofisi ya Mmušakarolo

Appendix H: Protocol Form (Study 3)

VOICE USE REDUCTION PROGRAM ASSESSMENT PhD PROTOCOL					
Participant Number:					
Adherence Letter ☐					
Date:					
PERCEPTUAL EVALUATION: (Voice recorded)					
Read Rainbow Passage ☐					
G=	R=	B=	A=	S=	I=
Grade of hoarseness	Roughness	Breathiness	Asthenia	Strain	Instability
ACOUSTIC EVALUATION:					
Multidimensional Voice Program (sampling rate @ 50 000Hz)					
Jitter (%):		Shimmer (%):		Fundamental frequency (Hz):	
Harmonics-to-noise ratio (dB):			MPT /A/:		
/S/:			/Z/:		
Voice Range Profile					
Frequency (Hz)		Max:		Min:	
Intensity (dB)		Max:		Min:	
Fundamental		Max:		Min:	
Dysphonia Severity Index					
DSI Score = (-5 to +5; the more – the score, possibility of hyperfunction/pathology; the more + the more normal functioning)					
Participant Number:					
Adherence Letter ☐					
Date:					
PERCEPTUAL EVALUATION 2: (Voice recorded)					
Read Rainbow Passage ☐					
G=	R=	B=	A=	S=	I=
Grade of hoarseness	Roughness	Breathiness	Asthenia	Strain	Instability
ACOUSTIC EVALUATION 2:					
Multidimensional Voice Program (sampling rate @ 50 000Hz)					
Jitter (%):		Shimmer (%):		Fundamental frequency (Hz):	
Harmonics-to-noise ratio (dB):			MPT:		
/S/:			/Z/:		
Voice Range Profile 2					
Frequency (Hz)		Max:		Min:	
Intensity (dB)		Max:		Min:	
Fundamental		Max:		Min:	
Dysphonia Severity Index 2					
DSI Score = (-5 to +5; the more – the score, possibility of hyperfunction/pathology; the more + the more normal functioning)					

Appendix I: Voice Use Reduction Programme

Clinical Focus



The Voice Use Reduction Program

Anita van der Merwe

University of Pretoria, South Africa

The purpose of this article is to describe a structured behavior modification approach to the reduction of voice use by clients with voice disorders. The Voice Use Reduction (VUR) Program is conceptualized as part of a comprehensive approach to the treatment of voice. The VUR Program provides guidelines for the classification of voice use situations, the assignment of voice use units to different situations, and the calculation of the maximum number of units per day and per week in a

severe, moderate, and low voice use reduction program. Two case examples are described to illustrate the application of the VUR Program. The results of an evaluation of the VUR Program by 10 female students who presented with vocal nodules and applied the program also are included.

Key Words: voice rest, voice conservation, voice use reduction

A reduction in the amount of voice use, also referred to as *relative* or *modified* voice rest, is regularly mentioned as an important part of voice conservation and voice treatment (Colton & Casper, 1996; Deem & Miller, 2000; Holmberg, Hillman, Hammerberg, Södersten, & Doyle, 2001; Lavorato & McFarlane, 1988; Pannbacker, 1999; Sataloff, 2001; Stemple, Glaze, & Klaben, 2000). The rationale for reducing voice use is to promote laryngeal health in clients who present with laryngeal injury, laryngeal pathology, or vocal fatigue and also to prevent further damage and fatigue. In cases of acute vocal fold trauma such as hemorrhage, mucosal tearing, and trauma due to burns, *absolute* voice rest, in which the person does not speak at all, is necessary (Sataloff, 2001). Nevertheless, absolute voice rest should not exceed more than a few days; a period of 3 days is often sufficient (Andrews, 1999; Sataloff, 2001). Aronson (1990) suggested that absolute voice rest could do harm due to psychological reactions of the client and the loss of muscle tone. Absolute voice rest should, therefore, only be prescribed for a few days in cases of acute trauma; however, relative voice rest is indicated whenever vocal fold injury, pathology, or vocal fatigue is present.

Reduced voice use may facilitate the process of tissue repair. The vocal folds are susceptible to trauma and disease that can result in tissue damage and histological changes. When specialized tissue is destroyed or injured, a stereotyped response, *repair*, follows. It is important that the location of tissue repair is not disrupted and that the process is allowed to take its course (Goepel, 1996). Whenever the vocal folds are edematous, inflamed, or injured, the voice must be used sparingly to reduce the frequency of vocal fold contact and irritation of the mucosa. High-impact forces created during laryngeal

hyperfunction, excessive use of voice, and efforts to compensate for the hoarseness that results from the pathology can disrupt the process of repair (Andrews, 1999; Colton & Casper, 1996; Deem & Miller, 2000; Hirano, 1974). A reduction in voice use may create circumstances in which repair can take place.

The current voice use reduction methods described in the literature tend to be vague in instructions to voice clients and may not be maximally effective. Many voice clinicians encourage their clients to reduce voice use. Techniques such as "charting when, where and for how long voice is used" (Colton & Casper, 1996, p. 300) and voice diaries or logs (Casper, 2000; Harris, 2000) are used to obtain information on voice use and the reduction of voice use. Time limits for the use of voice are imposed, and clients are also made aware of the concept of voice resources and their responsibility to decide how, where, and when voice resources should be spent (Andrews, 1999; Deem & Miller, 2000; Stemple, 2000a, 2000b). All of these methods do have great value but lack descriptions of procedural detail.

Further challenges to successful voice use reduction include emotional issues, personality traits, and occupational demands of clients. The recommendation by a voice clinician to reduce the amount of voice use has important implications for the social and occupational life of the person with a voice disorder. Clients are not always willing to comply and may resist overtly or covertly the request to curtail voice use. According to Aronson (1990), "it is difficult to convince others how deeply voice disorders strike at the heart of the patient's total being and how special voice is in the average person's emotional and intellectual life" (p. 261). Emotional and personality factors are not necessarily the direct cause of a voice

disorder, but they can be (Aronson, 1990; Roy & Bless, 2000b; Stemple et al., 2000). Psychological and personality factors are even considered important in the development of “functional” disorders (Roy & Bless, 2000b). Research has indicated that people with vocal nodules display elevated levels of extraversion, are group dependent (a people’s person), show high levels of boldness, and are exuberant and cannot control their exuberance (Grey, van der Merwe, & Daws, 2002; Roy, Bless, & Heisey, 2000). Clients with vocal nodules are the most relevant group for voice use reduction, as nodules are caused by repetitive mucosal injury. However, these clients often appear to be unable to stop vocal overuse and abuse, in spite of the obvious harmful effects (Roy & Bless, 2000a, 2000b). Due to all the reasons mentioned above, clients with voice disorders often find it difficult to curtail their voice use and need specific guidelines on how to modify the amount of voice use.

Behavior modification theory provides valuable guidelines for the development of a voice use reduction program. The first guideline is that positive reinforcement (reward) can be used to modify behavior (Houston, 1981; Kazdin, 1980; Martin & Pear, 1992). The principle of positive reinforcement is considered to be “the single most important part of the learning process” (Martin & Pear, 1992, p. 30). In a behavior modification program, positive reinforcement is provided for a target behavior to strengthen that behavior. For example, a decrease in behavioral excess (such as excessive eating or drinking) or an increase in acceptable behavior (such as studying or exercising more) is rewarded (Kazdin, 1980; Martin & Pear, 1992). Positive reinforcers can be consumable, manipulative, possessional, and social (Martin & Pear, 1992). Social reinforcement, including praise and informative feedback, is relevant to voice use reduction and can be powerful (Kazdin, 1980). The achievement of goals may facilitate feelings of improved confidence, self-gratulation, and motivation to change behavior (Houston, 1985; Martin & Pear, 1992).

A second guideline is that behavior modification requires a careful description of the target behavior and a clear statement of the goal (Kazdin, 1980; Schwitzgebel & Kolb, 1974). Martin and Pear (1992) pointed out that the most important characteristic of behavior modification is “its strong emphasis on defining problems in terms of behavior that can be *measured* in some way” (p. 7). Change in the behavioral measure of the problem is the best indicator of the extent to which the problem is being helped (Martin & Pear, 1992). Certain behaviors, termed *target* behaviors, are analyzed, and the goal of behavior modification is to change these target behaviors and monitor progress continuously and quantitatively (Houston, 1981; Schwitzgebel & Kolb, 1974). According to Martin and Pear (1992), there are no rigid sets of guidelines for the design of a behavior modification program, but the target behaviors and their desired level of occurrence should be identified, and details on data-recording and data-graphing procedures should also be specified. The client must be assisted in *specifying the problem in quantitative terms and setting quantifiable goals*. Quantification clarifies the problem behavior and makes assessment of the occurrence of such behavior more accurate.

When this approach is applied, the goal is exact, the client can monitor his or her own behavior, and the clinician can provide positive reinforcement when the quantified goal is reached (Kazdin, 1980; Martin & Pear, 1992).

A third guideline is that behavior modification through *self-control* is an accepted model for bringing about change in behavior (Kazdin, 1980; Martin & Pear, 1992). Change through self-control is indicated in instances where only the client can identify the occurrence of a behavior and where the problem behavior is due to a lack of self-control. Lack of self-control often stems from a conflict between the immediate consequences of behavior that are reinforcing (e.g., overeating) and delayed consequences that are punishing (e.g., becoming obese; Kazdin, 1980; Martin & Pear, 1992). An artificial arrangement on a temporary basis, where extrinsic reward reinforces the desired behavior, may be necessary to initiate a self-control behavior modification program (Kazdin, 1980). However, a client has to agree with the goals of a program and commit to change (Kazdin, 1980; Martin & Pear, 1992). Other components of behavior modification through self-control are to involve others who can assist in the achievement of goals and to rearrange the environment to provide frequent reminders of the commitment. In the case of excessive voice use, only the client has access to the problem behavior, and change can only be brought about by behavior modification through self-control.

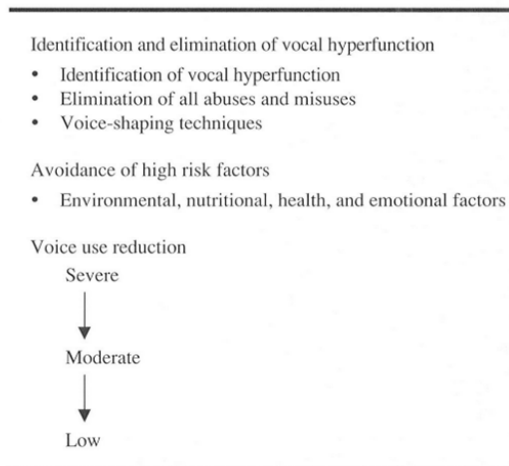
The need for a structured behavior modification approach to voice use reduction led to the development of the Voice Use Reduction (VUR) Program. This program was originally developed for a client with vocal trauma (see Case 1) but has since been found most beneficial in dealing with other voice disorders such as vocal nodules. The VUR Program has become an integral part of voice treatment at our university’s Speech, Voice, Language and Hearing Clinic. The program is not prescriptive with regard to all aspects, and clinicians have to apply some measure of clinical judgment to adapt the program to the needs of each client. The program can therefore be individualized to address the unique situation of each client (American Speech-Language-Hearing Association, 1998). The purpose of this article is to describe the structure of the VUR Program and to explain the development of an individual program for a client.

The VUR Program is described in depth in the following sections. To begin, the VUR Program is placed within the broader context of voice treatment, and an overview of the program is presented. Next, each of the treatment stages of the VUR Program and the steps to be followed during each stage are explained. Then, two case examples are described to illustrate how the program can be adapted to the needs of individual clients. Finally, an evaluation of the VUR Program by 10 clients with vocal nodules is discussed.

Voice Use Reduction Within the Broader Context of Voice Treatment

Figure 1 depicts the VUR Program within the broader context of voice treatment. Voice treatment calls for a

Figure 1. Voice use reduction within the broader context of voice treatment.



comprehensive approach that addresses voice production and voice use habits and also exposure to different high-risk factors that could contribute to and aggravate voice disorders. All forms of vocal abuse and misuse (Boone & McFarlane, 1988) should be identified and eliminated through voice treatment. Exposure to high-risk factors, which include environmental, nutritional, health, and emotional variables, should be reduced (Child & Johnson, 1991). Voice use reduction and the VUR Program should be regarded as just one component of a holistic approach (Stemple et al., 2000) to voice treatment.

Overview of the Voice Use Reduction Program

In the VUR Program, the problem behavior is specified in quantitative terms, quantifiable goals are set, and the client is instructed on how to apply this self-control program. Voice use in all *communication situations* in which a client engages is quantified by allocating a certain number of *voice use units* to each situation. The number of units assigned to each situation depends on the effect communication in a certain situation has on the voice of the client. The more detrimental the effect, the more voice use units are assigned. By having quantifiable behaviors, measurable goals can be set for the client (Houston, 1981; Martin & Pear, 1992). The client is allowed to use a specified maximum number of units per day and per week. How these units are spent is the decision of the client. The client is therefore still responsible for his or her own behavior and has to exercise self-control.

The program starts with a period of severe voice use reduction, and as the voice improves, progress is made to a period of moderate and then low voice use reduction. The duration of each period is determined by improvement in the condition of the vocal folds, in voice quality, and/or in the subjective experience of vocal fatigue, vocal effort, and

laryngeal pain by the client. As progress is made to moderate and low voice use reduction, the client is allowed to use progressively more voice use units per day and per week. The three periods of voice use reduction are referred to as *stages* in the VUR Program. The fact that there are three stages in voice use reduction may be motivational for the client. This helps to reassure the client that severe voice use reduction will not be indefinite and that progress can be made to less restrictive levels of voice use reduction over time. Progress to a next stage also signifies improvement and the achievement of a short-term goal. This can foster compliance with the program. The three stages are also beneficial from a clinical perspective. They allow for a period during which the voice can improve maximally, followed by the gradual reintroduction of communication in specific situations, while the effect on vocal fold pathology and voice production is monitored.

Throughout application of the VUR Program, voice use units are displayed graphically for the client and clinician to review. The clinician prepares a graph for each client, indicating the number of voice use units on the y-axis and the days of the week and the number of weeks on the x-axis (see, e.g., Figures 2 and 3). The maximum number of units that is allowed per day can also be indicated on the graph. The maximum number of voice use units actually used should be counted by the client and marked on the graph. Counting and graphing of behavior are conducive to behavior modification because they show the achievement (or not) of goals (Houston, 1981; Martin & Pear, 1992). If the goals are achieved, the clinician should praise the client to positively reinforce the reduction in voice use.

The process of developing a VUR Program can start during the first session with the client. Most of the second session can be used to develop a VUR Program for the period of severe voice use reduction. During all subsequent treatment sessions, at least 10 min should be allocated to discuss the number of voice use units used during the time between treatment sessions. Time should also be allocated for laryngoscopic examinations, acoustic and/or perceptual analyses of voice quality, and discussion of the improvement made during the different stages.

The Voice Use Reduction Program

Table 1 shows the three stages of the VUR Program (severe, moderate, and low voice use reduction) and the steps to be followed during each stage. These are discussed below.

Stage 1: Severe Voice Use Reduction

The VUR Program begins with severe voice use reduction. The duration of this period and the stringency of voice use reduction will depend on the severity of the vocal fold condition or voice disorder.

Step 1: Identify the voice use situations. Identification of the situations in which the client uses his or her voice is central to the VUR Program. The focus of questioning is to obtain information about the vocational, social, and recreational use of voice. The process starts during the

Table 1. Stages and steps of the voice use reduction program.

Stage	Step
Severe voice use reduction	Step 1: Identify the voice use situations
	Step 2: Analyze the voice use situations
	Step 3: Classify and rate the voice use situations
	Step 4: Determine the maximum number of voice use units per day and per week
	Step 5: Monitor improvement in the condition of the vocal folds and voice
Moderate voice use reduction	Step 1: Add previously proscribed situations to the list
	Step 2: Determine the maximum number of voice use units per day and per week
	Step 3: Monitor improvement in the condition of the vocal folds and voice
Low voice use reduction	Step 1: Add previously proscribed situations to the list
	Step 2: Determine the maximum number of voice use units per day and per week
	Step 3: Monitor improvement in the condition of the vocal folds and voice

initial interview. At least 15 min are spent identifying situations in which the voice is habitually and occasionally used. Voice use situations are, for example, presenting lectures, performing in front of an audience, making professional phone calls, and socializing in noisy environments. The client is given an assignment to bring along a complete list of voice use situations for discussion during the second session. The client should also exercise self-observation in the different situations, to determine the effect of each situation on the voice.

Step 2: Analyze the voice use situations. The different voice use situations are analyzed with regard to environmental conditions, the presence of high-risk factors, the frequency and duration of voice use in these situations, and, most important, the cumulative effect each situation has on the voice as the client experiences it. The criteria to determine the cumulative effect are the degree of self-perceived vocal fatigue, vocal effort, laryngeal pain, and the deterioration of voice quality during communication in the situation and the hours after it. The level of emotional stress (e.g., nervousness, fear, and anger) the client experiences should also be considered. A certain situation may seem free of obvious high-risk factors, but the client may find it very stressful, and for that reason, the voice fatigues excessively when used in that situation. For example, a situation may be stressful if the client perceives the communication partner or the audience as critical or aggressive. The analysis of the different voice use scenarios provides the ideal situation for helping the client to understand the nature of the problem (Lavorato & McFarlane, 1988) and to explain the effect of excessive voice use and the need for a reduction in voice use.

Step 3: Classify and rate the voice use situations. Once all the communication situations have been identified and

Table 2. Examples of voice use situations and the assigned units.

Units	Voice use situations
1	Intermittent use of voice at home or work in optimum communication conditions (no background noise or communication competition) for basic communication to convey most important information during 1 day.
2	Use of voice in conversation (i.e., intermittent) for 30 min or a 10-min telephone conversation in optimum conditions using a soft voice.
3	Use of voice in conversation (i.e., intermittent) in the conditions described above for 1 hr.
4	Use of voice in conversation (i.e., intermittent) in unfavorable communication situations for 30 min. Uninterrupted use of voice for 5 to 10 min in unfavorable communication conditions. A period longer than this is not allowed, but if it does happen, 6 or more units are assigned.
5	Uninterrupted voice use such as during the presentation of a lecture in optimum conditions for 30 min or intermittent professional voice use for 1 hr.
6	Uninterrupted voice use in optimum conditions for 1 hr (2 hr can be assigned 9 or more units) or intermittent professional voice use for 2 hr.

analyzed, they are assigned unit values. The suggested definitions in Table 2 provide guidelines for assigning voice use units to situations. The rating of voice use situations calls for subjective judgment but is based on the criteria mentioned in Step 2. The client describes the situation and its effect on the voice to the clinician. The clinician, in cooperation with the client, assigns unit values to each situation. It might be necessary to observe the client in some situations before rating these situations. It is also important to record the time usually spent in a certain situation, as the application of the VUR Program may impose time limits on certain situations (see Table 2).

Ratings of 1 to 6 voice use units are adequate to cover a range of social and professional voice use situations that can usually be allowed during severe voice use reduction. Progressively more units are assigned to situations that make more demands on the voice (such as uninterrupted voice use, the need for increased loudness levels, and communication in stressful situations) and may have a more harmful effect. One unit is assigned to situations that are least harmful to the voice. A situation assigned 1 unit presupposes intermittent and quiet use of voice in optimum communication conditions for basic communication purposes. Situations assigned 2 to 4 units primarily allow for social voice use, but these units may also be allocated to professional voice use situations. Situations assigned 5 and 6 units can be reserved for professional activities to allow the client some measure of professional voice use. A situation assigned 5 units allows the client, for example, uninterrupted voice use in optimum conditions for 30 min or intermittent professional voice use for 1 hr. A situation assigned 6 units allows uninterrupted voice use in optimum conditions for 1 hr or intermittent professional voice use for 2 hr.

To cover the range of situations in which a client communicates, the list of situations can be extended beyond those assigned 6 units. For example, uninterrupted professional voice use in optimum conditions for 2 hr can be assigned 9 units or more. However, these situations assigned more than 6 units would usually not be allowed during severe voice use reduction.

Step 4: Determine the maximum number of voice use units per day and per week. In the VUR Program, the client may continue quiet and intermittent voice use in optimum communication conditions. Basic communication needs could therefore be fulfilled. Consequently, the calculation of the maximum number of voice use units per day during all three stages always includes this 1 unit for basic communication.

Before the maximum number of voice use units per day can be calculated, the *most highly rated situation that is allowed* should be determined. This decision calls for a subjective judgment by the clinician. Voice use in situations assigned 6 units *cannot* be allowed during severe voice use reduction if the condition of the vocal folds (e.g., when acute vocal fold trauma is present) contraindicates voice use in such situations *or* if these situations lead to an increase in self-perceived vocal fatigue, vocal effort, laryngeal pain, and deterioration in voice quality. In these instances, situations assigned 6 units should be proscribed during severe voice use reduction, and the most highly rated situations that are allowed should be situations assigned 5 units or less.

To determine the maximum number of units per day, the units assigned to the most highly rated situation

allowed (e.g., 6 units) are added to 1 unit. The sum of these two determines the maximum number of units that may be used during 1 day. In the case of severe voice use reduction, the maximum number per day therefore will be 7 units. If the client does use the 6 units for communication in a situation assigned 6 units, 1 unit will remain for only basic communication during the rest of that day. The voice will therefore be relatively rested during the rest of the day. If the client does not use the 6 units for voice use in a situation assigned 6 units, the available 6 units can be used for professional or social purposes in more than one situation which is assigned less than 6 units (see Table 2). The client has the freedom to use the units as required. The calculation of maximum number of units per day is summarized in Table 3.

A maximum number of voice use *units per week* also is imposed. This maximum is set to ensure that the voice is not used maximally every day and that there are days of the week during which the voice is relatively rested. The maximum number of units per day (e.g., 7 during severe voice use reduction) may only be used on 4 of the 7 days of the week, and on the remaining 3 days, only 1 unit per day will be available for basic communication. During severe voice use reduction, the maximum number of units per week is therefore 31. The way in which the maximum number of units per week is calculated is demonstrated in Table 4.

This method of voice use reduction allows the client to continue voice use in situations assigned 5 or 6 units for professional purposes 4 days per week. However, the limitation per week also induces minimum voice use on every alternative day, after 2 days of maximum voice use or on 3 consecutive days of a particular week. Maximum voice use on some days of the week will be alternated with days during which voice rest and repair can take place.

Step 5: Monitor improvement in the condition of the vocal folds and voice. Improvement in the condition of the vocal folds and in voice should be monitored periodically

Table 3. Maximum number of voice use units per day in a severe, moderate, and low Voice Use Reduction Program.

Stage	Maximum no. voice use units per day
Severe voice use reduction	Allow 1 unit for basic communication, plus the units for the highest rated situations allowed (e.g., 6), $\Rightarrow 1 + 6 = 7$ per day.
Moderate voice use reduction	Allow 1 unit for basic communication, plus the 6 units for the highest rated situations allowed, plus another 3 units for social or professional voice use. If the highest rated situations allowed remain 6-unit situations, $\Rightarrow 1 + 6 + 3 = 10$ per day. If the highest rated situations allowed are increased to 9-unit situations, $1 + 9 = 10$ per day.
Low voice use reduction	Allow 1 unit for basic communication, plus the 6 units for the highest rated situations allowed, plus another 5 units for social or professional voice use. If the highest rated situations allowed remain 6-unit situations, $\Rightarrow 1 + 6 + 5 = 12$ per day. If the highest rated situations allowed are increased to 11-unit situations, $1 + 11 = 12$ per day.

Note. These are only general guidelines; the clinician can use her or his discretion.

Table 4. Maximum number of voice use units per week in a severe, moderate, and low Voice Use Reduction Program.

Stage	Maximum no. voice use units per week
Severe voice use reduction	Allow the maximum number of units per day (e.g., 7) for 4 days, plus 3 for basic communication on the 3 remaining days (3×1) $\Rightarrow (7 \times 4) + 3 = 31$ units per week.
Moderate voice use reduction	Allow the maximum number of units per day (e.g., 10) for 4 days, plus 3 for basic communication on the 3 remaining days (3×1) $\Rightarrow (10 \times 4) + 3 = 43$ units per week.
Low voice use reduction	Allow the maximum number of units per day (e.g., 12) for 4 days, plus 3 for basic communication on the 3 remaining days (3×1) $\Rightarrow (12 \times 4) + 3 = 51$ units per week.

Note. These are only general guidelines; the clinician can use his or her discretion.

during treatment. Indirect laryngoscopic examinations and acoustic and/or perceptual voice analyses should be performed at least every 4 weeks—more often, if circumstances permit. A laryngologist should perform the indirect laryngoscopic examinations to determine if the condition of the vocal folds is improving. The clinician may, however, collect vocal tract visualization and imaging data to supplement the report from the laryngologist (American Speech-Language-Hearing Association, 2004). Acoustic analyses of voice quality should be augmented by perceptual evaluations of improvement by the clinician and also by a panel of listeners who are not aware of what stage of therapy is represented in a voice sample. The client and clinician should also regularly discuss improvement in the subjective experience of the client.

Criteria for progress to moderate voice use reduction depend on the symptoms and/or signs the client presents with initially. The clinician should consider the relevant factors in each client. If vocal fold pathology is present, a decrease in the size of nodules, improvement in the color of the vocal folds (becoming less red), less inflammation, and less edema indicate that the condition is improving. The improvement in the condition of the voice can also be monitored by acoustic and/or perceptual analyses. Voice quality should improve as pathology subsides. The subjective report by the client of a decrease in vocal fatigue, vocal effort, or laryngeal pain can also be a criterion for improvement.

If the condition of the vocal folds and vocal functioning do not improve and vocal fatigue, vocal effort, or laryngeal pain do not decrease, the rigor of the program should be increased. If the problem can be pinned down to a certain voice use situation, that situation must be assigned more voice use units and proscribed during the severe voice use reduction period.

Stage 2: Moderate Voice Use Reduction

After the period of severe voice use reduction, progress can be made to moderate voice use reduction. The client is now allowed more voice use units. The severe voice use reduction of the previous stage is rewarded, and the client will experience the achievement of a goal. These elements are necessary components of successful behavior modification (Houston, 1981; Martin & Pear, 1992).

Step 1: Add previously proscribed situations to the list. The maximum number of units per day is increased during moderate voice use reduction. Situations assigned 7 to 9 units can now be added. The addition of more highly rated situations is a mutual decision by the clinician and client. The effect each situation has on the voice remains the determining factor. No new situations have to be added to the list.

Step 2: Determine the maximum number of voice use units per day and per week. The guidelines for calculating the maximum number of voice use units per day remain as they were during severe voice use reduction (see Table 3). The maximum number of units per day can be increased to 10. This maximum will allow the client 1 unit for basic communication, 6 units for voice use in a

situation assigned 6 units, and an additional 3 units (which were not available during severe voice use reduction). The additional 3 units imply that the client is allowed professional voice use as well as social voice use in the course of a single day.

If more highly rated situations are added to the list, the client can now use 9 units for a situation assigned 9 units, and 1 unit will remain for basic communication during 1 day. The same rationale as during severe voice use reduction applies here. Voice use in the most highly rated situation allowed leaves only 1 unit for basic communication during the rest of a particular day.

The maximum number of units per week also is increased, but again, the client cannot use the maximum number for more than 4 days of the week. The maximum number of units per week during the stage of moderate voice use reduction is 43. If the maximum of 10 units per day is used for 4 days (10×4), only 3 units will be available for basic communication on the 3 remaining days of the week (see Table 4).

Step 3: Monitor improvement in the condition of the vocal folds and voice. During the period of moderate voice use reduction, progress should be monitored by laryngoscopic examinations, acoustic and/or perceptual voice analyses, and the subjective report of progress by the client. The criteria for progress to low voice use reduction should be normal or near normal vocal folds and voice characteristics. If the vocal folds have been severely injured, it may be unrealistic to expect complete recovery. The limits of the voice may be imposed by permanent changes in the shape or structure of the mucosa (Colton & Casper, 1996). In these instances, a marked improvement in the condition of the folds and in voice quality will be sufficient indications for progress to low voice use reduction. Before progress to low voice use reduction is made, clients should also report no or very little vocal fatigue, vocal effort, or laryngeal pain during the period of moderate voice use reduction.

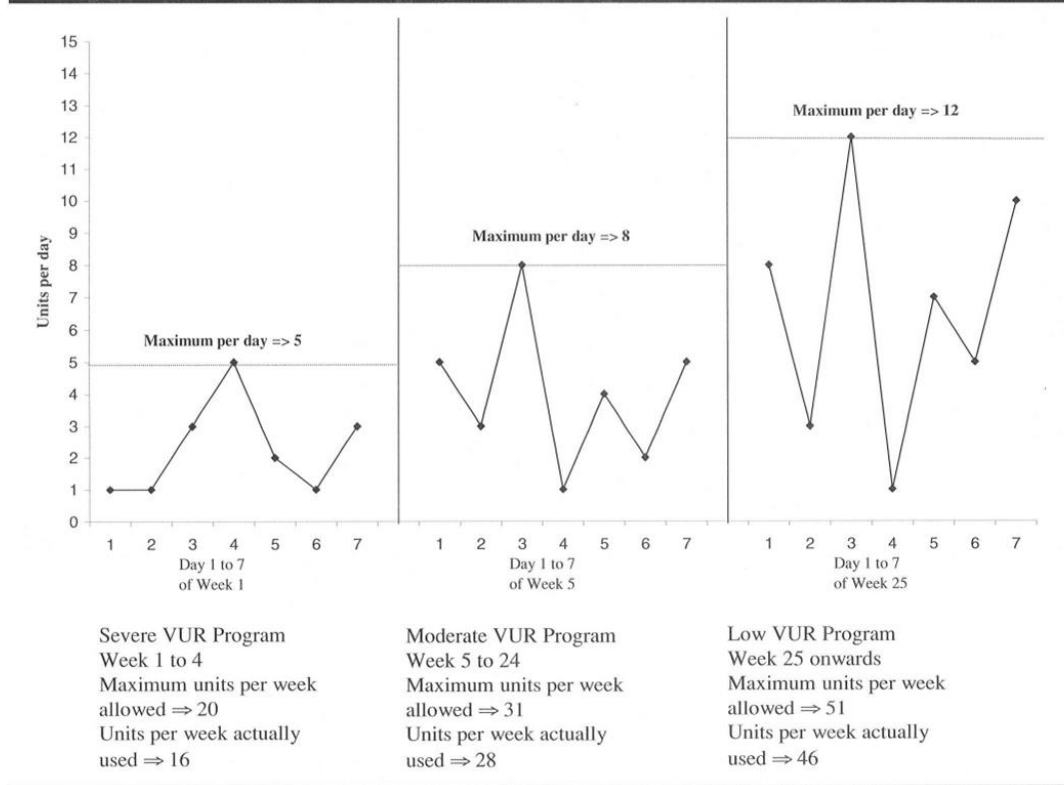
Stage 3: Low Voice Use Reduction

The last stage of the VUR Program is a period of low voice use reduction. Voice use is still curtailed, but the client can now use his or her voice more freely. In some cases, the client is advised to continue with this stage of the program, even after regular treatment sessions are discontinued.

Step 1: Add previously proscribed situations to the list. At this stage, the client is usually ready to take up most voice commitments that were previously discontinued. Those situations (if any) that were assigned 10 units or more can now be added to the list. The duration of voice use in certain situations can also be extended at this stage, but the ratings of those situations should then be increased.

Step 2: Determine the maximum number of voice use units per day and per week. The maximum number of voice use units per day is increased to 12 and the number of units per week is increased to 51 (see Tables 3 and 4). During 1 day, the client can use 1 unit for basic communication, 6 for a situation assigned 6 units, and another 5

Figure 2. Maximum number of voice use units per day and the actual units used per day during three periods of severe, moderate, and low voice use reduction in Case 1. Only the data of the 1st week of each period are indicated, to illustrate a typical example of voice use during each of the three periods. VUR = Voice Use Reduction.



units (which is more than during the previous stages) for professional or social use. Another alternative is to use 1 unit for basic communication, 9 for a situation assigned 9 units, and another 2 (which were not available during moderate voice use reduction) for social use. If the clinician so decides, these maximums can be higher. These are only general guidelines, and the clinician can manipulate the number of units according to the needs of the client. The maximum per week is determined in exactly the same way as during the other stages.

Step 3: Monitor improvement in the condition of the vocal folds and voice. Weekly treatment sessions can be continued for 2 to 3 weeks during low voice use reduction. The condition of the vocal folds and the voice still have to be monitored during this stage. Before treatment is discontinued, it is important to ensure that voice use in those situations previously proscribed does not lead to a recurrence of vocal fold damage, deterioration in voice characteristics, or vocal fatigue, vocal effort, or laryngeal pain. At least two follow-up appointments during the following 2 to 6 months are important to ensure that no relapse has occurred.

Case Examples

Two case examples are discussed to illustrate how the VUR Program was adapted to the needs of two clients who had to reduce voice use as part of voice treatment. These case examples are modeled after actual cases, but certain details have been changed for illustrative purposes.

Case 1

History of the problem. Case 1 was a 56-year-old woman who had undergone surgery after severe Reinke's edema was diagnosed. Reinke's edema occurs when the superficial layer of the lamina propria (Reinke's space) becomes filled with viscous fluid due to chronic misuse of the laryngeal mechanism (Colton & Casper, 1996; Stemple et al., 2000). Case 1 used her voice professionally as a part-time lecturer, politician, and journalist. After the surgery, she continued to misuse her voice. She started voice treatment 1 month after the operation, and at the time, she could only produce a very hoarse and soft voice with effort. Indirect laryngoscopy by the physician revealed red and swollen vocal folds.

Course of treatment. At the start of treatment, the client was unable to use her voice professionally. She decided to give up her posts as lecturer and political candidate, but it was agreed that she would still do journalistic interviews if these were conducted in optimum communication situations. These were the first steps taken to reduce voice use. However, her voice still fatigued easily, and no real improvement in the condition of the vocal folds and quality of the voice occurred. It became clear that social use of the voice would also have to be curtailed. The VUR Program was then developed to guide this client in the management of amount of voice use.

Case 1 was put on a VUR Program for longer periods and with lower maximum voice use units per day and per week than is usually necessary. The rigorous VUR Program was indicated due to the serious condition and slow repair of the vocal folds. The severe VUR Program lasted 4 weeks, the moderate VUR Program lasted 20 weeks, and low voice use reduction lasted indefinitely. The maximum number of voice use units per day and per week during severe voice use reduction was initially restricted to 5 per day and 20 per week. During the moderate voice use reduction period, these values were 8 and 31. These maximums are much lower than the guidelines provided in Tables 3 and 4. The rationale for 5 units per day during severe voice use reduction was that she could communicate intermittently during the day in optimum conditions and make two short phone calls per day. That amount of communication brought her to 5 units per day. If she chose to have an interview, the time limit was 1 hr (5 voice use units), and the rest of the day she had to rest her voice completely. The maximum units of 20 per week implied that she could only use the maximum of 5 per day on 3 days of the week (3×5). The remaining 5 units then had to be distributed among the other 4 days of the week. The maximums were based on the same considerations described earlier. Data for the three stages of the program are indicated in Figure 2.

Pre- and posttreatment evaluation. Indirect laryngoscopy, which was performed regularly, suggested improvement in the condition of the vocal folds. The results of two voice analyses done during the initial phase of treatment and 6 months later indicated improvement of all the parameters of voice (van der Merwe & Groenewald, 1997). Perceptually, the voice improved across time, as judged by the clinician. Vocal fatigue after voice use also decreased. During follow-up contact, she reported that she continued to restrict voice use because excessive use resulted in her voice becoming hoarse and fatigued. However, she was able to resume an increasing number of journalistic commitments. The conclusion was reached that improvement in voice did occur during the application of the VUR Program.

Case 2

History of the problem. Case 2 was a 20-year-old student in performing arts. Before university training, she took part in singing and dramatic arts activities but did not experience voice problems. Her university training included singing classes and participation in stage productions. She

Table 5. Voice use situations and the assigned units of Case 2.

Units	Voice use situations
1	Intermittent talking at home in optimum conditions
2	Attending class and intermittent chatting with a friend in the presence of a fair amount of background noise; 10-min phone call
3	Intermittent chatting in a small group, where there is laughing and some communication competition for 30 min
4	Intermittent chatting for 30 min in a coffee shop, where there is background music and people smoking; intermittent chatting for 45 min in the dining hall of the students' hostel, where there are many people talking simultaneously; intermittent voice use during choir practice of light classical songs for 30 min
5	One-hour rehearsal of a stage production in which she does not have a big role; intermittent voice use during choir practice of light classical songs for 1 hr; individual singing class for 30 min
6	Two-hour rehearsal of a stage production in which she has an important role but speaks only intermittently; the actual show before an audience; Shakespeare rehearsals, in which voice use is more demanding than in the play, for 1 hr
12	One day of a weekend choir camp (1 unit for basic communication + 11-unit use)

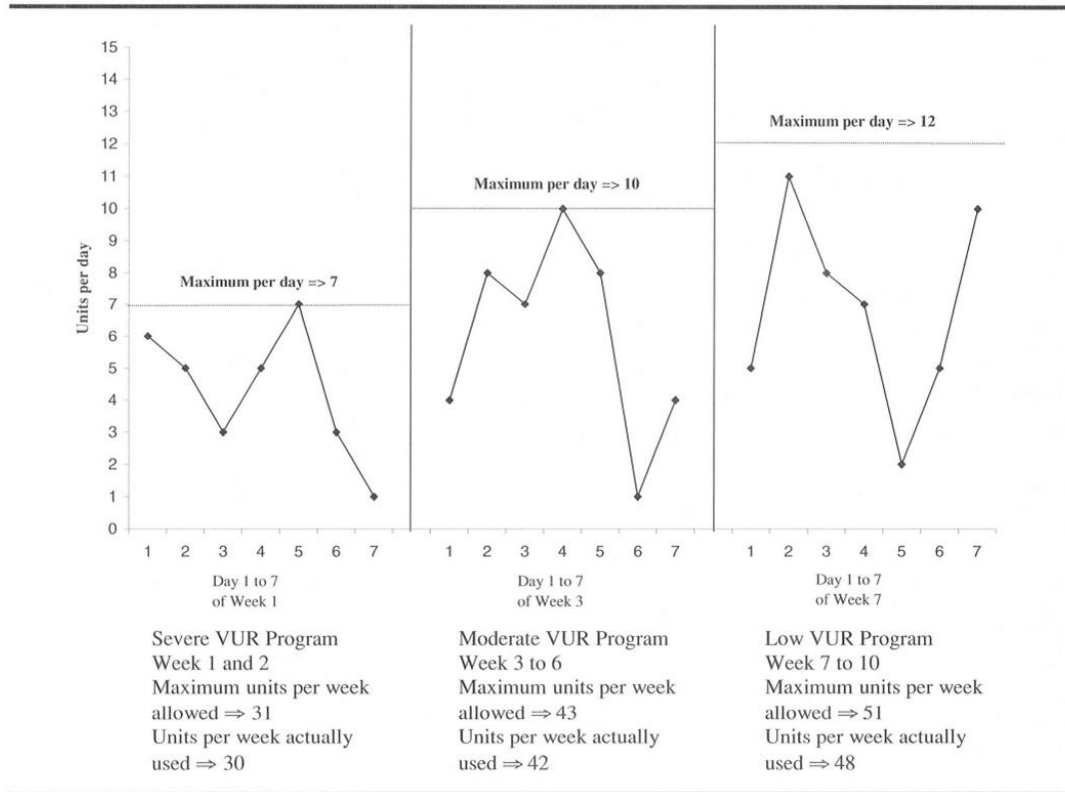
was also a member of the university choir and regularly attended weekend choir camps. During the course of her studies, her voice became increasingly hoarse, and small vocal nodules were diagnosed by the laryngologist at the time of referral for treatment.

Course of treatment. This student had a set program for each week, which was used to list all voice use situations. These situations and the units assigned are summarized in Table 5. The maximum voice use units per day and per week for Case 2 were in accordance with the guidelines provided in Tables 3 and 4. The actual units used during the three periods are indicated in Figure 3. Treatment with the VUR Program lasted for 10 weeks.

Pre- and posttreatment evaluation. At the time of referral, two small bilateral nodules were present. After 2 weeks of severe voice use reduction, the nodules were still visible but had decreased in size. After 6 weeks of moderate voice use reduction and during all follow-up examinations, nodules were no longer visible.

Acoustic voice analyses were performed before the onset of treatment, after 2 weeks of severe voice use reduction, and 6 weeks after the first analysis. The Kay CSL 4300B Multidimensional Voice Profile (MDVP) was used. The results of the MDVP before treatment commenced revealed values that differed from the norms with regard to most parameters. After 2 weeks of severe voice use reduction, all the parameters had improved or were within the normal range. The final analysis was performed after she had attended a weekend choir camp, and all parameters remained as during the previous analysis. Perceptually, the voice quality improved across time, as

Figure 3. Maximum number of voice use units per day and the actual units used per day during three periods of severe, moderate, and low voice use reduction in Case 2, who presented with vocal nodules. Only the data of the first week of each period are indicated, to illustrate a typical example of voice use during each of the three periods.



judged by the clinician. The client also reported a decrease in vocal fatigue and vocal effort.

Results of a Questionnaire on the Value of the VUR Program

The VUR Program has been applied in our clinic for the past 5 years and has been used with approximately 40 clients. To determine how clients perceived this program, 10 female students who also participated in another study (Grey et al., 2002) were asked to complete a questionnaire on the value of the VUR Program. All had vocal nodules at the time of referral, and in all of them, the nodules remitted spontaneously during the course of treatment. The results of the questionnaire are summarized in Table 6.

The questionnaires revealed that 4 of the 10 respondents regarded the VUR Program as most valuable. They consistently agreed fully with the statements in the questionnaire and added remarks such as, "It took a lot of self-discipline and perseverance," "I found it very hard to keep to the maximums but my voice improved a lot," or "The program was (and still is) of extreme value." The other 6 respondents

agreed with the statements in the questionnaire most of the time. There was just 1 participant who agreed only to some extent with Statements 4, 8, and 10.

The results seemed to indicate that all 10 participants agreed to a large extent or fully that the VUR Program was an important part of their voice treatment. It was interesting that they considered the program helpful in becoming aware of voice production errors (Statement 6), because that was not one of the goals of the VUR Program. The results of Statements 4 and 8 indicated that not all of the respondents reduced the amount of voice use but most of them learned to *manage* the amount of voice use. Such a result was important, as research by Grey et al. (2002) found this group to have exuberant personalities with low levels of constraint.

Conclusion

The primary goals in voice treatment are to improve the condition of the vocal folds and a return of the best possible voice. To create conditions for optimum repair of the vocal folds and improvement in the functioning of the

Table 6. Results of the questionnaire on the value of the VUR Program, as perceived by 10 female students who had vocal nodules.

Statement	Do not agree at all	Agree to some extent	Agree	Agree to a large extent	Agree fully
1. The VUR Program was an important part of the voice treatment I received.	0	0	0	4	6
2. The VUR Program made me aware of the potential danger of speaking in certain situations.	0	0	0	2	8
3. The VUR Program made me aware of the way I use my voice.	0	0	0	4	6
4. The VUR Program helped me to reduce the amount of voice use.	0	1	4	1	4
5. The VUR Program provided me with a method of voice conservation that I can continue applying in the future.	0	0	4	2	4
6. The VUR Program made me aware of my voice production errors.	0	0	0	4	6
7. The VUR Program helped me to understand voice conservation.	0	0	0	4	6
8. The VUR Program helped me to manage the amount of voice use.	0	1	1	2	6
9. The VUR Program made me aware of the fact that I have to take responsibility for conserving my voice.	0	0	0	2	8
10. The VUR Program contributed to the improvement of my voice problem.	0	1	1	2	6

vocal mechanism, the voice clinician often has to prescribe a reduction in voice use. The lack of self-control by the client, or occupational and social demands, may challenge compliance with such a request. Usually clients who have a voice disorder also have to manage the amount of voice use indefinitely. To facilitate voice use reduction and to bring about long-term changes in the amount of voice use, the VUR Program applies principles of behavior modification. This program differs from existing literature in the sense that guidelines for quantifying voice use and for setting quantifiable goals are described. The VUR Program introduces the concepts of voice use units, the allocation of units to voice use situations, and maximum number of voice use units per day and per week. These concepts can be implemented by persons with voice disorders and also by any professional speaker, as a tool to manage optimum amount of voice use. The application of the VUR Program under the initial supervision of a voice clinician may instill the concept of voice resources and management thereof. The client can continue to apply the principles of the program after treatment has been discontinued.

Preliminary data indicate that clients do find the VUR Program an important part of voice treatment. Further research can document the contribution of the VUR Program in vocal fold repair and improvement in voice quality. It is also necessary to determine if the application of the VUR Program does indeed modify the amount of voice use. Data on the amount of voice use units a person uses before and after the introduction of the VUR Program may yield important information. A multiple-baseline across-people design, a control group design, or an alternating treatment design can all be implemented to assess behavior change (Kazdin, 1980; Martin & Pear, 1992). Further research may clearly document the contribution of the VUR Program in voice treatment.

References

- American Speech-Language-Hearing Association. (1998). *ASHA preferred practice patterns for voice: Voice assessment; voice treatment*. Rockville, MD: Author.
- American Speech-Language-Hearing Association. (2004).

Vocal tract visualization and imaging: Position statement.

Asha (Suppl. 24). 64.

- Andrews, M. L. (1999). *Manual of voice treatment: Pediatrics through geriatrics* (2nd ed.). San Diego, CA: Singular.
- Aronson, A. E. (1990). *Clinical voice disorders: An interdisciplinary approach* (3rd ed.). New York: Thieme.
- Boone, D. R., & McFarlane, S. C. (1988). *The voice and voice therapy* (4th ed.). Englewood Cliffs, NJ: Prentice Hall.
- Casper, J. (2000). Treatment approaches and measurement of vocal function: Confidential voice. In J. C. Stemple (Ed.), *Voice therapy: Clinical studies* (2nd ed., pp. 128–139). San Diego, CA: Singular Thomson Learning.
- Child, D. R., & Johnson, T. S. (1991). Preventable and nonpreventable causes of voice disorders. *Seminars in Speech and Language*, 12(1), 1–13.
- Colton, R. H., & Casper, J. K. (1996). *Understanding voice problems: A physiological perspective for diagnosis and treatment* (2nd ed.). Baltimore: Williams & Wilkins.
- Deem, J. F., & Miller, L. (2000). *Manual of voice therapy*. Austin, TX: Pro-Ed.
- Goepel, J. R. (1996). Responses to cellular injury. In J.C.E. Underwood (Ed.), *General and systematic pathology* (2nd ed., pp. 121–127). New York: Churchill Livingstone.
- Grey, L., van der Merwe, A., & Daws, L. (2002). Die verband tussen persoonlikheid en stemhiperfunksie by 'n bepaalde groep sprekers [The relationship between personality and voice hyperfunction in a specific group of speakers]. *Health South Africa*, 7(4), 57–69.
- Harris, S. (2000). The accent method in clinical practice. In J.C. Stemple (Ed.), *Voice therapy: Clinical studies* (2nd ed., pp. 62–75). San Diego, CA: Singular Thomson Learning.
- Hirano, M. (1974). Morphological structure of the vocal cord as a vibrator and its variations. *Folia Phoniatrica*, 26, 89–94.
- Holmberg, E. B., Hillman, R. E., Hammarberg, B., Södersten, M., & Doyle, P. (2001). Efficacy of a behaviorally based voice therapy protocol for vocal nodules. *Journal of Voice*, 15, 395–412.
- Houston, J. P. (1981). *Fundamentals of learning and memory* (2nd ed.). New York: Academic Press.
- Houston, J. P. (1985). *Motivation*. New York: Macmillan.
- Kazdin, A. E. (1980). *Behavior modification in applied settings*. Homewood, IL: Dorsey Press.
- Lavorato, A. S., & McFarlane, S. C. (1988). Counseling clients with voice disorders. *Seminars in Speech and Language*, 9, 237–253.
- Martin, G., & Pear, J. (1992). *Behavior modification: What it is*

- and how to do it (4th ed.). Englewood Cliffs, NJ: Prentice Hall.
- Pannbacker, M.** (1999). Treatment of vocal nodules: Options and outcomes. *American Journal of Speech-Language Pathology*, 8, 209–217.
- Roy, R., & Bless, D. M.** (2000a). Personality traits and psychological factors in voice pathology: A foundation for future research. *Journal of Speech, Language, and Hearing Research*, 43, 737–748.
- Roy, R., & Bless, D. M.** (2000b). Toward a theory of the dispositional bases of functional dysphonia and vocal nodules: Exploring the role of personality and emotional adjustment. In R. D. Kent & M. J. Ball (Eds.), *Voice quality measurement* (pp. 461–480). San Diego, CA: Singular.
- Roy, R., Bless, D. M., & Heisey, D.** (2000). Personality and voice disorders: A superfactor trait analysis. *Journal of Speech, Language, and Hearing Research*, 43, 749–768.
- Sataloff, R. T.** (2001). Vocal health. *The voice foundation*. Retrieved October 23, 2001, from <http://www.voicefoundation.org/vfSATALOFFVocalHlt.htm>
- Schwitzgebel, R. K., & Kolb, D. A.** (1974). *Changing human behavior: Principles of planned intervention*. New York: McGraw-Hill.
- Stemple, J. C.** (2000a). Vocal function exercises. In J. C. Stemple, (Ed.), *Voice therapy: Clinical studies* (2nd ed., pp. 34–46). San Diego, CA: Singular Thomson Learning.
- Stemple, J. C.** (2000b). Vocal hyperfunction in children: Therapy with limited parental interaction. In J. C. Stemple (Ed.), *Voice therapy: Clinical studies* (2nd ed., pp. 98–102). San Diego, CA: Singular Thomson Learning.
- Stemple, J. C., Glaze, L., & Klaben, B. G.** (2000). *Clinical voice pathology theory and management*. San Diego, CA: Singular Thomson Learning.
- van der Merwe, A., & Groenewald, E.** (1997). Voice conservation in a case of acute vocal trauma. *Clinica: Applications in Clinical Practice of Communication Pathology, Monograph 2*, 79–86.

Received April 10, 2002

Accepted March 30, 2004

DOI: 10.1044/1058-0360(2004/022)

Contact author: Anita van der Merwe, PhD, Department of Communication Pathology, University of Pretoria, Pretoria 0002, South Africa. E-mail: anita.vandermerwe@up.ac.za

Appendix J: VUR Programme Infographic

THE VOICE USE REDUCTION (VUR) PROGRAMME

1 RATIONALE

We implement reduction of voice use as a therapy program to promote laryngeal health in clients who present with laryngeal pathology, injury or vocal fatigue due to high vocal demand such as professional voice users.



2 MISUSE AND ABUSE



First, we must attempt to consciously eliminate all vocally abusive and misuse behaviours from our daily lives. This may include excessive talking, throat clearing, coughing, inhaling irritants, smoking, screaming, speaking too loudly (yelling) or at an abnormally high or low pitch.

3 ASSIGNING VOICE UNITS

Voice use in all communication situations are quantified by assigning a certain number of voice use units to each situation. The number of units assigned is linked to how detrimental the situation is to the voice. The client is thus only allowed to use a certain amount of voice units per day and per week. How these voice units are spent is up to the client.

4 THE STAGES OF VUR

In total, there are 3 stages of the VUR program.

1. Severe voice use reduction 2. Moderate voice use reduction & 3. Low voice use reduction. Progress to the next stage is determined by improvement of vocal fold condition, voice quality, vocal fatigue or effort, and laryngeal pain experienced. Note: Stage 1 is only used if laryngeal injury or pathology is present.



5 YOUR VUR PROGRAM



Step 1: Identify voice use situations. Think about your social, vocational/occupational and recreational voice use daily situations. Step 2: Rate the voice use situation by voice units. The suggested definitions in Table 2 provide guidelines on allocating units to situations. Step 3: Determine max units per day and per week

Appendix K: Moderate and Low VUR Infographic

Moderate & Low Voice Use Reduction



Moderate Voice Use Reduction

The maximum number of voice units per day under a moderate voice use reduction is 10 units. This allows the client 1 unit for basic communication, 6 units for voice use situation assigned 6 units, and an additional 3 units for professional or social use.

The maximum number of voice units per week under moderate voice use reduction is 70 units. The client can decide how these units are allocated



Low Voice Use Reduction

The maximum number of voice units per day under a low voice use reduction is 12 units. This allows the client 1 unit for basic communication, 6 units for voice use situation assigned 6 units, and an additional 5 units for professional or social use.

The maximum number of voice units per week under moderate voice use reduction is 84 units. The client can decide how these units are allocated.



Appendix L: Proof of acceptance of article to Journal of Speech, Language and Hearing Research

JSLHR Manuscript Decision

External

Inbox

JSLHR

Tue, 16 Aug 2022, 00:55

em@editorialmanager.com

to me

CC: awans@usf.edu, "Dr. Maria Du Toit" maria.dutoit@up.ac.za, "Prof. Jeannie van der Linde" jeannie.vanderlinde@up.ac.za, "Prof. Kristiane van Lierde" kristiane.vanlierde@ugent.be

Ref.: Ms. No. JSLHR-22-00097R2

The effect of vocal hygiene education programs on voice quality in professional voice users: A systematic review.

Journal of Speech, Language, and Hearing Research

Dear Dr. Vermeulen,

I am pleased to accept your manuscript for publication in Journal of Speech, Language, and Hearing Research.

If you haven't already selected the open access option, please consider doing so now. Choosing the open access publishing option can increase readership, online attention, and citation levels. ASHA assesses an article processing charge (APC) of \$2,000 for the open access option. You can find out more about Open Access by visiting <https://academy.pubs.asha.org/asha-journals-author-resource-center/manuscript-submission/open-access/>

To find out more about the ASHA production process, please visit:

<https://academy.pubs.asha.org/asha-journals-author-resource-center/production-steps/>

Thank you for the opportunity to review and publish your work.

Sincerely,

Shaheen N. Awan PhD ASHA-F

Editor

Journal of Speech, Language, and Hearing Research

Appendix M: Proof of acceptance of article to Journal of Voice

Decision on submission to Journal of Voice

External

Inbox

Journal of Voice

<em@editorialmanager.com>Manuscript Number: JVOICE-D-22-00504R1

Self-reported vocal demands, perceptions and knowledge of occupational voice users

Dear Mrs Vermeulen,

Thank you for submitting your manuscript to Journal of Voice.

I am pleased to inform you that your manuscript has been accepted for publication.

My comments, and any reviewer comments, are below.

Your accepted manuscript will now be transferred to our production department. We will create a proof which you will be asked to check, and you will also be asked to complete a number of online forms required for publication. If we need additional information from you during the production process, we will contact you directly.

We appreciate and value your contribution to Journal of Voice. We regularly invite authors of recently published manuscript to participate in the peer review process. If you were not already part of the journal's reviewer pool, you have now been added to it. We look forward to your continued participation in our journal, and we hope you will consider us again for future submissions.

Kind regards,

Robert T. Sataloff, MD, DMA, FACS
Editor-in-Chief

Journal of Voice

Appendix N: Proof of submission of article to Folia Phoniatica et Logopaedica

<https://orcid.org/0000-0003-1722-3692>

[Start a new submission](#)

	Submission/Title/Type	Status	Action
 Delete [Author files]	Confirmed as: Corresponding Author Manuscript ID: FPL-2023-6-2 The outcomes of the Voice Use Reduction programme on voice quality and vocal fatigue in occupational voice users Type: Research Article Authors: Rouxjeanne Vermeulen (Corresponding Author), Maria Du Toit (Co-author), Kristiane M Van Lierde (Co-author), Marien Alet Graham (Co-author), (Co-author) Submitted: 2023-06-05	Submitted	

Correspondence

See messages sent to you



FPL-2023-6-2 Manuscript submission confirmation

External

Inbox x



Folia Phoniatria et Logopaedica <fpl@manuscriptmanager.net>

13:16 (1 hour ago)



to me ▼

Manuscript: FPL-2023-6-2 - The outcomes of the Voice Use Reduction programme on voice quality and vocal fatigue in occupational voice users
 Authors: Rouxjeanne Vermeulen (Corresponding Author), Maria Du Toit (Co-author), Kristiane M Van Lierde (Co-author), Marien Alet Graham (Co-author), (Co-author)
 Date submitted: 2023-06-05

Dear Dr. Vermeulen

Thank you very much for submitting the above manuscript. Please refer to the manuscript number in all correspondence concerning the manuscript as listed above.

Please ensure that all co-authors confirm that you have the authority to act on their behalf by having them click the verification link on the submission confirmation email they have received.

The manuscript will now be forwarded to our Editors and reviewers and we shall inform you as soon as a decision has been made by the editorial board.

The progress of your manuscript can be followed in the progress report that can be accessed from your account overview.

Sincerely,
 The Editorial Office

Appendix M: Examples of The Voice Use Reduction programme participant graphs in study 3 (Van Der Merwe, 2004)

