

Psychometric properties of the Vocal Fatigue Index – Thai Version

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ABSTRACT

Background: Voice disorders can be found in many scenarios. Many people have experienced vocal problems in their lifetime. Such problems can occur occasionally or permanently during the course of life. Previous literature review showed that vocal fatigue usually occurs concurrently with voice disorders, though it could occur alone as well. Vocal fatigue is considered the first symptom of a vocal problem and usually improves after voice rest. Detecting vocal fatigue before an individual develops a voice disorder is extremely important.

Objectives: This study aims to 1) translate the original VFI into the Thai version and 2) evaluate the psychometric properties of VFI-TH, including content validity, face validity, predictive validity (sensitivity and specificity), and reliability.

Materials and methods: Participants in this study consisted of two groups comprising one group of 22 participants with voice disorders and another group of 60 participants with healthy voices. The age of participants was 18 years and older.

Procedures: Cross-cultural protocol of translation was followed per Beaton, which consisted of five steps: Initial translation, synthesis of the translation, back translation, expert committee review, and pretesting. This study was divided into 2 phases. Phase I consisted of the first three steps of Beaton's guideline, while Phase II was the evaluation of psychometric properties; content validity by expert committee review, face validity by data trial in ten participants with voice disorders, predictive validity through sensitivity and specificity by formula calculation, and reliability were examined by evaluating internal consistency through Cronbach's Alpha co-efficiency.

Results: The results showed that the VFI-TH had content validity, face validity, and predictive validity. For predictive validity, the percentages of sensitivity and specificity were 22.7 and 100, respectively, and internal consistency was 0.87-0.94, which meant very good or excellent.

Conclusion: The VFI-TH had content validity, specificity, and reliability to detect vocal fatigue. However, the VFI-TH should be used along with other vocal assessments in adults aged 18 years and older.

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Introduction

Voice disorders can occur among professionals who use their voices often, such as teachers, singers, actors, lawyers, salespeople, and non-occupational voice users.^{1,2} Most disorders are caused by using the voice for a long time, using inappropriate pitch and loudness, shouting, as well as screaming, and talking at a high pitch. These kinds of manipulations of voice use can lead to temporary or permanent voice problems that affect daily lives.³ The American Speech-Language-Hearing Association (ASHA) defines voice disorders as those that occur when voice quality, pitch, and loudness differ or are inappropriate for an individual's age, gender, cultural background, or geographic location.⁴⁻⁶ Voice disorders also appear when an individual expresses concern about having an abnormal voice that does not meet daily needs, even if others do not perceive it as different or deviant.⁷⁻¹⁰ Common symptoms include aphonia, hoarseness, harshness, muscle strain, and vocal fatigue. Vocal fatigue is regarded as the first sign of a voice disorder.

There is no definition for vocal fatigue in the Classification Manual for Voice Disorders-I.¹¹ On the other hand, many symptoms indicate vocal fatigue, such as excessive effort while speaking, tiredness, voice loss during speaking, and worsening vocal quality.¹² Indications of vocal fatigue may not be detected by direct endoscopic examination of the larynx.^{3,13} Per literature, in consensus, vocal fatigue is defined as a quantifiable decline in function (performance or perceptual) that influences vocal task performance and is individual-specific.¹² At present, the measurement of vocal fatigue mostly involves using individual self-reported questionnaires, among which the most widely accepted and used is the Vocal Fatigue Index.¹⁴

The Vocal Fatigue Index, or VFI, is a questionnaire that was developed by Nanjundeswaran in 2015.¹⁴ The VFI consists of nineteen questions divided into three parts. Part 1 is related to the tiredness of the voice and avoidance of voice use. Part 2 is related to physical discomfort, while part 3 is related to improving symptoms with rest. This test utilizes a Likert scale score from 0-4, and each part is interpreted independently. The original VFI has different cut-off scores for each part. The cut-off score for part 1 is ≥ 24 , while for part 2 it is ≥ 7 , and for part 3 it is ≤ 7 . Individuals with vocal fatigue should meet the criteria for both parts 1 and 3. The VFI has been translated into many languages including Portuguese,¹⁵ German,¹⁶ Indian,^{17,18} Persian,¹⁹ Turkish,²⁰ Hong Kong-Chinese,²¹ Croatian,²² Korean,²³ Japanese,²⁴ etc.

In Thailand, Speech-Language Pathologists (SLPs) have limited available voice assessment tools, and none of them are specific for the evaluation of vocal fatigue. Accordingly, Thai SLPs provided with the VFI Thai version would be able to use it as a tool for early detection of vocal fatigue before individuals develop other problems due to voice disorders. It could be helpful for therapists to diagnose and prevent voice problems among individuals who seek voice therapy at an early stage.

Materials and methods

This study consisted of two phases: 1) translation and cross-cultural adaptation of the VFI following Beaton's guidelines²⁵ and 2) psychometric properties evaluation of the VFI-TH. The VFI developer accepted the author's request for permission to translate on July 16th, 2018. The study was approved by the Research Ethics Committee of the Faculty of Associated Medical Sciences, Chiang Mai University (Approval ID: AMSEC-61EX-098) and the Ethics Committee on Researches Involving Human Subjects Rajavithi Hospital (EC number: 090/2019).

Participants

There were two groups of participants: Twenty-two participants with voice disorders and sixty with healthy voices.

1. Voice disorders group

The inclusion criteria were age over 18 years old, and the ability to speak and read in Thai. Participants had to have presented with voice disorders in the last six months with the frequency of voice problems most or all of the time, have symptoms of laborious speaking, and/or the ability of pronunciation increased, and/or changing of vocal quality, and diagnosed with voice disorders with benign lesions by an otolaryngologist. The exclusion criteria included having psychiatric and/or neurological diseases that could affect understanding the questionnaire, using/getting psychiatric medication, and inability to do the questionnaire by themselves.

2. Normal voice group

The inclusion criteria were; age over 18 years old, the ability to speak and read in Thai, and the absence of voice problems in the last six months. If any voice issues had occurred in the previous six months, the frequency and duration of the problems must have been less than two weeks.

Procedures

Phase 1: Translation and cross-cultural adaptation of the VFI

In this process, the focus was on translation across cultures, for which the author followed Beaton's Guidelines.²⁵ The guidelines suggest five stages when translated in a cross-culture setting: Initial translation, synthesis of the translation, back translation, expert committee review, and pretesting. The last two stages are shown in the second phase. The steps and details for the first phase of this study are as follows:

1.1 Initial translation

The first step was forward translation using two expert translators with independent backgrounds who were unfamiliar with the VFI. The first translator (T1) was an otolaryngologist knowledgeable in voice disorders. T1 translated the original into VFI-T1. The second translator (T2) was a linguistics professor who translated into VFI-T2.

1.2 Synthesis of the translation

The two translators (T1 and T2) and the first two authors synthesized the results of translations (VFT-T1 and VFI-T2) to produce one synthesized translation (VFI-T12).

1.3 Back translation

Another two independent translators who were experts in the English and Thai languages translated VFI-T12 from Thai into English. This step had VFI-BT1 and VFI-BT2.

Phase 2: Psychometric properties evaluation of the VFI-TH

This part consisted of four evaluation steps. The first two steps involved the procedure in Beaton's guidelines, including expert committee review and pretesting, which are also called content validity and face validity, respectively. Subsequently, predictive validity was carried out through the assessment of sensitivity and specificity of the VFI-TH and reliability.

I. Validity

2.1 Expert committee review

An expert committee review is also called an evaluation of content validity. The conference of the expert committee was set for May 31st, 2019. There were two Speech-Language Pathologists (SLPs) who were experienced in voice disorders and one laryngologist who specialized in laryngeal problems. The meeting between experts involved reviewing content, making equivalent cross-cultural outputs, and editing differences found according to the opinion of the experts. This step produced the VFI-expert version.

2.2 Pretesting

The last stage of the cross-cultural protocol was pretesting. The trial applied the VFI-expert version to ten participants who had voice disorders with benign lesions. Interpreting vocal fatigue results and collecting comments and/or the part that should be fixed were done after participants completed the index by the first author. The

VFI-expert version was adjusted through face validity and proofreading, then getting the VFI-TH version.

2.3 Predictive validity through sensitivity and specificity

Sensitivity is the ability of a test to correctly identify patients with vocal fatigue (True Positive) and individuals with voice disorders.²⁶⁻²⁸ Specificity is the ability of a test to correctly identify people without vocal fatigue (True Negative) and individuals with no voice disorders.^{28,29} It is used to confirm a screening test's ability and differentiate between individuals who have vocal fatigue and those who do not.²⁸ Table 1 shows sensitivity and specificity by comparing the standard test and the VFI-TH.

Table 1 Determination of sensitivity and specificity.^{28, 29}

The VFI-TH	Standard test	
	Voice disorders	No voice disorders
Vocal fatigue	a (True Positive)	b (False Positive)
No vocal fatigue	c (False Negative)	d (True Negative)
	$\text{Sensitivity} = \frac{a}{(a+c)}$	$\text{Specificity} = \frac{d}{(b+d)}$

II. Reliability

Reliability for this study analyzed the internal consistency for each part of the VFI-TH and total items using Cronbach's Alpha co-efficiency.

Results

The demographic data for all participants are shown in Tables 2 and 3.

Table 2 Demographic information for 22 voice disorder participants.

	n	(%)		n	(%)
1. General information			2. Voice problems		
Gender			Voice problems in the last six months		
Male	11	(50)	Yes	22	(100)
Female	11	(50)	No	0	(0)
Age			Frequency		
18-29	2	(9.1)	Sometime	9	(41)
30-39	5	(22.7)	Most of the time	5	(23)
40-49	2	(9.1)	Always	8	(36)
50-59	4	(18.2)	Duration (weeks)		
≥60	9	(40.9)	<2	4	(18)
Level of education			≥2	18	(82)
< Bachelor's degree	8	(36.4)	Voice therapy		
Bachelor's degree	11	(50)	Yes	10	(45.5)
Master's degree	3	(13.6)	No	12	(54.5)
> Master's degree	0	(0)	3. Medical information		
Occupation			Lesion		
Teacher/professor	1	(4.55)	Structural		
Religious leader	1	(4.55)	Vocal nodules	4	(18.2)
Farmer	2	(9.1)	Vocal polyps	2	(9.1)
Merchant	3	(13.6)	Vocal edema	1	(4.5)

Table 2 Demographic information for 22 voice disorder participants. (continued)

	n	(%)		n	(%)
Etc.	15	(68.2)	Granuloma	2	(9.1)
Engineer	1	-	Neurological		
Journalist	1	-	TVC paralysis	13	(59.1)
Nurse	1	-	Vocal tremor	0	(0)
Dietitian	1	-	Bowing cord	0	(0)
Office worker	1	-	Spasmodic dysphonia	0	(0)
Writer	1	-	Underlying diseases		
Retired government officer	2	-	Diabetes mellitus	1	-
Government officer	2	-	Hypertension	1	-
Lawyer	1	-	Laryngopharyngeal reflux	6	-
No work	3	-	Deny underlying diseases	10	-
Job involves continuous voice use			Etc.		
Yes	11	(50)	Heart disease	2	-
No	11	(50)	Allergic rhinitis	3	-
Average voice use in a day (hours)			Thyroid	1	-
<1	1	(9.1)	Dyslipidemia	1	-
1-3	7	(63.6)			
4-6	3	(27.3)			
>6	0	(0)			

Table 3 Demographic information for 60 typical participants.

	n	(%)		n	(%)
1. General information			1. General Information (cont.)		
Gender			Job involves continuous voice use		
Male	20	(33.3)	Yes	41	(68.3)
Female	40	(66.7)	No	19	(31.7)
Age			Average voice use in a day (hours)		
18-29	11	(18.3)	<1	0	(0)
30-39	32	(53.3)	1-3	18	(43.9)
40-49	8	(13.3)	4-6	12	(29.3)
50-59	2	(3.3)	>6	11	(26.8)
≥60	7	(11.8)	2. Voice problems		
Level of education			Voice problems in the last six months		
< Bachelor's degree	6	(10)	Yes	11	(18.3)
Bachelor's degree	27	(45)	No	49	(81.7)
Master's degree	18	(30)	Frequency		
> Master's degree	9	(15)	Sometime	11	(100)
Occupation			Most of the time	0	(0)
Teacher/professor	10	(16.7)	Always	0	(0)
Religious leader	1	(1.7)	Duration (weeks)		
Merchant	4	(6.6)	<2	11	(100)
Student	1	(1.7)	≥2	0	(0)
Salesman	6	(10)	Voice therapy		
Interpreter/guide	2	(3.3)	Yes	0	(0)
Technician	1	(1.7)	No	11	(100)

Table 3 Demographic information for 60 typical participants. (continued)

	n	(%)		n	(%)
Etc.	35	(58.3)	3. Medical information		
Office worker	13	-	Underlying diseases		
Retired	3	-	Diabetes mellitus	1	-
Nurse	5	-	Hypertension	2	-
Doctor	2	-	Laryngopharyngeal reflux	1	-
Administrator	2	-	Deny underlying diseases	50	-
Audiologist	2	-	Etc.		
Psychologist	1	-	Allergic rhinitis	6	-
Dietarian	1	-	Thyroid	1	-
Journalist	1	-			
Speech-language pathologist	1	-			
Government officer	1	-			
Freelance consultant	1	-			
Self-employed	1	-			
Accountant	1	-			

Validity

Validity in this study was analyzed by 1) content validity through expert committee review, 2) face validity through pretesting or trial, and 3) predictive validity through calculating sensitivity and specificity.

1. Content validity

In the meeting, editing of the context was carried out for cultural adaptation in some questions and adding descriptions to provide additional information to increase

understanding. Examples include item no.5 "It feels like work..." no.12 "pain in the neck", and no.15 "throat aches", as shown in Figure 1 and Figure 2. Explanations were added such as "having voice disorders involves focusing on using the voice like at work when compared with a normal voice that is speaking natural", "pain on the muscle of the neck", and "when using voice, it is a sudden pain", respectively. Experts held discussions until they formed a consensus and got the VFI-expert version.

Part 1					
1. I don't feel like talking after a period of voice use	0	1	2	3	4
2. My voice feels tired when I talk more	0	1	2	3	4
3. I experience increased sense of effort with talking	0	1	2	3	4
4. My voice gets hoarse with voice use	0	1	2	3	4
5. It feels like work to use my voice	0	1	2	3	4
6. I tend to generally limit my talking after a period of voice use	0	1	2	3	4
7. I avoid social situations when I know I have to talk more	0	1	2	3	4
8. I feel I cannot talk to my family after a workday	0	1	2	3	4
9. It is effortful to produce my voice after a period of voice use	0	1	2	3	4
10. I find it difficult to project my voice with voice use	0	1	2	3	4
11. My voice feels weak after a period of voice use	0	1	2	3	4
Part 2					
12. I experience pain in the neck at the end of the day with voice use	0	1	2	3	4
13. I experience throat pain at the end of the day with voice use	0	1	2	3	4
14. My voice feels sore when I talk more	0	1	2	3	4
15. My throat aches with voice use	0	1	2	3	4
16. I experience discomfort in my neck with voice use	0	1	2	3	4
Part 3					
17. My voice feels better after I have rested	0	1	2	3	4
18. The effort to produce my voice decreases with rest	0	1	2	3	4
19. The hoarseness of my voice gets better with rest	0	1	2	3	4

These are some symptoms usually associated with voice problems. Circle the response that indicates how frequently you experience the same symptoms (0-never, 1-almost never, 2-sometimes, 3-almost always, and 4-always).

Figure 1. The Vocal Fatigue Index-Original (VFI).¹⁴

รหัส

หน้า 1 ของ 2 หน้า

แบบประเมินดัชนีวัดการล้าของเสียงฉบับภาษาไทย
(Vocal Fatigue Index – Thai Version)

คำแนะนำ อาการเหล่านี้มักสัมพันธ์กับปัญหาของเสียง

ให้ท่านวงกลมล้อมรอบคำตอบ ที่บ่งชี้ว่าท่านประสบกับอาการแบบเดียวกันบ่อยเพียงไร

- คะแนน** 0 หมายถึง ไม่เคย
(อาการดังกล่าวไม่เคยปรากฏขึ้น)
- 1 หมายถึง แทบไม่เคย
(อาการดังกล่าวปรากฏขึ้นน้อยครั้ง แต่แต่ละครั้งปรากฏขึ้นห่างกัน)
- 2 หมายถึง บางครั้ง
(อาการดังกล่าวปรากฏขึ้นนานๆครั้ง แต่ปรากฏบ่อยครั้งมากขึ้น)
- 3 หมายถึง เกือบตลอดเวลา
(อาการดังกล่าวปรากฏขึ้นเกือบตลอดเวลา)
- 4 หมายถึง ตลอดเวลา
(อาการดังกล่าวปรากฏขึ้นตลอดเวลา)

ตอนที่ 1		ไม่เคย	แทบไม่เคย	บางครั้ง	เกือบตลอดเวลา	ตลอดเวลา
1	ข้าพเจ้ารู้สึกไม่ยากพูดคุยหลังจากการใช้เสียงมาระยะเวลาหนึ่ง	0	1	2	3	4
2	ข้าพเจ้ารู้สึกเหนื่อยเมื่อพูดมากขึ้น	0	1	2	3	4
3	ข้าพเจ้าต้องออกแรงมากขึ้นในขณะที่พูด	0	1	2	3	4
4	ข้าพเจ้ามีอาการเสียงแหบเมื่อใช้เสียง	0	1	2	3	4
5	ข้าพเจ้ารู้สึกเหมือนทำงานขณะใช้เสียง	0	1	2	3	4
6	ข้าพเจ้ามีแนวโน้มที่จะจำกัดการพูดคุยหลังจากการใช้เสียงมาระยะเวลาหนึ่ง	0	1	2	3	4
7	ข้าพเจ้าหลีกเลี่ยงสถานการณ์ทางสังคมเมื่อรู้ว่าข้าพเจ้าต้องพูดคุยมากขึ้น	0	1	2	3	4
8	ข้าพเจ้ารู้สึกว่าไม่สามารถพูดคุยกับครอบครัวหลังจากทำงานมาทั้งวัน	0	1	2	3	4
9	ข้าพเจ้าต้องออกแรงเปล่งเสียงมากหลังจากการใช้เสียงมาระยะเวลาหนึ่ง	0	1	2	3	4

ฉบับที่ 3 วันที่ 4 มีนาคม 2563

Figure 2. The Vocal Fatigue Index-Thai Version (VFI-TH).

10	ข้าพเจ้าพบว่ามีความยากลำบากในการเปล่งเสียง	0	1	2	3	4
11	ข้าพเจ้าพูดเสียงเบาลงเมื่อใช้เสียงมาระยะเวลาหนึ่ง	0	1	2	3	4
คะแนนรวม						

หมายเหตุ

“รู้สึกเหมือนทำงาน” หมายถึง เมื่อมีปัญหาเสียงผิดปกติ ต้องฝืนใช้เสียงเหมือนทำงาน แต่เมื่อเทียบกับการไม่มีปัญหาเสียง การพูดนั้นจะเป็นไปตามธรรมชาติ

ตอนที่ 2		ไม่เคย	แทบไม่เคย	บางครั้ง	เกือบตลอดเวลา	ตลอดเวลา
12	ข้าพเจ้ารู้สึกปวดกล้ามเนื้อคอเมื่อสิ้นสุดวันที่มีการใช้เสียง	0	1	2	3	4
13	ข้าพเจ้ารู้สึกเจ็บในลำคอเมื่อสิ้นสุดวันที่มีการใช้เสียง	0	1	2	3	4
14	ข้าพเจ้ารู้สึกเจ็บ/แสบคอเมื่อพูดคุยมามากขึ้น	0	1	2	3	4
15	ข้าพเจ้าปวดในลำคอเมื่อใช้เสียง	0	1	2	3	4
16	ข้าพเจ้าไม่สบายคอเมื่อมีการใช้เสียง	0	1	2	3	4
คะแนนรวม						

หมายเหตุ

“ปวดกล้ามเนื้อคอ” หมายถึง ปวดกล้ามเนื้อภายนอกคอ
 “ปวดในลำคอเมื่อใช้เสียง” หมายถึง เมื่อมีการใช้เสียง รู้สึกปวดในลำคอทันที

ตอนที่ 3		ไม่เคย	แทบไม่เคย	บางครั้ง	เกือบตลอดเวลา	ตลอดเวลา
17	ข้าพเจ้ารู้สึกเสียงดีขึ้นหลังจากได้พัก	0	1	2	3	4
18	ข้าพเจ้าใช้แรงในการออกเสียงลดลงเมื่อได้พัก	0	1	2	3	4
19	อาการเสียงแหบของข้าพเจ้าลดลงเมื่อได้พัก	0	1	2	3	4
คะแนนรวม						

2. Face validity

Modification was done both in the general record form and the VFI-TH. Externally in record form (Figures 3 and 4), each question item and Likert score were highlighted for precise and easy understanding, and a description of

the score and word tabs in the score headline was added. A trial conducted on participants found that 4 of 10 participants offered feedback that most of the comments and suggestions needed further explanation.

หน้า 1 ของ 2 หน้า

หน้า 1

แบบบันทึกข้อมูลกลุ่มเสียงผิดปกติ

สำหรับการศึกษาแบบประเมินดัชนีวัดการล่าของเสียงฉบับภาษาไทย

วันที่	รหัส
ส่วนที่ 1 : ข้อมูลส่วนตัว	
1. เพศ	☐ ชาย ☐ หญิง
2. อายุ	☐ 18-29 ปี ☐ 30-39 ปี ☐ 40-49 ปี ☐ 50-59 ปี ☐ ตั้งแต่ 60 ปีขึ้นไป
3. ระดับการศึกษา	☐ น้อยกว่าปริญญาตรี ☐ ปริญญาตรี ☐ ปริญญาโท
4. อาชีพ	☐ นักเรียน/นักศึกษา ☐ ครู/อาจารย์ ☐ นักร้อง/นักแสดง ☐ พนักงานขาย ☐ ล่าม/มัคคุเทศก์ ☐ พระ/ผู้นำศาสนา ☐ ค้าขาย ☐ เกษตรกร ☐ ช่าง ☐ พนักงานขับรถ ☐ พนักงานทำความสะอาด ☐ ทำอาหาร ☐ พนักงานรักษาความปลอดภัย ☐ ระบุ
5. งานของท่านมีการใช้เสียงต่อเนื่องหรือไม่	☐ มี ☐ ไม่มี (ข้ามไปทำส่วนที่ 2)
6. จำนวนชั่วโมงเฉลี่ยที่ใช้เสียงต่อเนื่องใน 1 วัน	☐ น้อยกว่า 1 ชั่วโมง ☐ 1-3 ชั่วโมง ☐ 4-6 ชั่วโมง ☐ มากกว่า 6 ชั่วโมง
ส่วนที่ 2 : ปัญหาเสียงผิดปกติ	
1. ในช่วง 6 เดือนที่ผ่านมา	☐ มี ☐ ไม่มี (ข้ามไปทำข้อ 4)
2. ความถี่ของปัญหาเสียง	☐ นาน ๆ ครั้ง ☐ เป็นส่วนมาก ☐ ตลอดเวลา
3. ระยะเวลาของปัญหาเสียง	☐ น้อยกว่า 2 สัปดาห์ ☐ 2 สัปดาห์ ขึ้นไป
4. เคยได้รับการฝึกเสียงมาก่อนหรือไม่	☐ เคย ☐ ไม่เคย

** สำหรับผู้วิจัย เป็นผู้กรอกข้อมูล **

หน้า 2

รหัส			
ส่วนที่ 3: (สำหรับผู้วิจัย) ข้อมูลทางการแพทย์			
Lesion	Organic voice disorders Structural: ☐ Vocal nodule (Rt/Lt) ☐ Vocal polyp (Rt/Lt) ☐ Edema (Rt/Lt) ☐ Granuloma ☐ Neurological: ☐ TVC paralysis (Rt/Lt) ☐ Vocal tremor ☐ Bowing cord (Rt/Lt) ☐ Spasmodic dysphonia ☐		
U/D	☐ Diabetes Mellitus (DM) ☐ Hypertension (HT) ☐ Laryngopharyngeal Reflux (LPR) ☐		
VFI	Factors	VF score	Cut-off score
	Factor: 1*	Tiredness of voice and voice avoidance	≥ 24
	Factor: 2	Physical discomfort associated with voicing	≥ 7
	Factor: 3*	Improvement of symptoms with rest	≤ 7
	Vocal fatigue (factor 1,3) ☐ Yes ☐ No		

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แบบบันทึกข้อมูลกลุ่มเสียงปกติ
สำหรับการศึกษาแบบประเมินดัชนีวัดการล่าของเสียงฉบับภาษาไทย

วันที่	รหัส
ส่วนที่ 1 : ข้อมูลส่วนตัว	
1. เพศ	☐ ชาย ☐ หญิง
2. อายุ	☐ 18-29 ปี ☐ 30-39 ปี ☐ 40-49 ปี ☐ 50-59 ปี ☐ ตั้งแต่ 60 ปีขึ้นไป
3. ระดับการศึกษา	☐ น้อยกว่าปริญญาตรี ☐ ปริญญาตรี ☐ ปริญญาโท
4. อาชีพ	☐ นักเรียน/นักศึกษา ☐ ครู/อาจารย์ ☐ นักร้อง/นักแสดง ☐ พนักงานขาย ☐ ล่าม/มัคคุเทศก์ ☐ พระ/ผู้นำศาสนา ☐ ค้าขาย ☐ เกษตรกร ☐ ช่าง ☐ พนักงานขับรถ ☐ พนักงานทำความสะอาด ☐ ทำอาหาร ☐ พนักงานรักษาความปลอดภัย ☐ ระบุ
5. งานของท่านมีการใช้เสียงต่อเนื่องหรือไม่	☐ มี ☐ ไม่มี (ข้ามไปทำส่วนที่ 2)
6. จำนวนชั่วโมงเฉลี่ยที่ใช้เสียงต่อเนื่องใน 1 วัน	☐ น้อยกว่า 1 ชั่วโมง ☐ 1-3 ชั่วโมง ☐ 4-6 ชั่วโมง ☐ มากกว่า 6 ชั่วโมง
ส่วนที่ 2 : ปัญหาเสียงผิดปกติ	
1. ในช่วง 6 เดือนที่ผ่านมา	☐ มี ☐ ไม่มี (ข้ามไปทำข้อ 4)
2. ความถี่ของปัญหาเสียง	☐ นาน ๆ ครั้ง ☐ เป็นส่วนมาก ☐ ตลอดเวลา
3. ระยะเวลาของปัญหาเสียง	☐ น้อยกว่า 2 สัปดาห์ ☐ 2 สัปดาห์ ขึ้นไป
4. เคยได้รับการฝึกเสียงมาก่อนหรือไม่	☐ เคย ☐ ไม่เคย

** สำหรับผู้วิจัย เป็นผู้กรอกข้อมูล **

หน้า 2

รหัส			
ส่วนที่ 3: (สำหรับผู้วิจัย) ข้อมูลทางการแพทย์			
U/D	☐ Diabetes Mellitus (DM) ☐ Hypertension (HT) ☐ Laryngopharyngeal Reflux (LPR) ☐		
VFI	Factors		VF score Cut-off score
	Factor: 1*	Tiredness of voice and voice avoidance	≥ 24
	Factor: 2	Physical discomfort associated with voicing	≥ 7
	Factor: 3*	Improvement of symptoms with rest	≤ 7
Vocal fatigue (factor 1,3)		☐ Yes ☐ No	

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3. Predictive validity

Sensitivity was calculated for twenty-two individuals who were diagnosed with voice disorders. It was found that only five participants had vocal fatigue because they met the criteria for parts 1 and 3, while seventeen participants

had no vocal fatigue, as shown in Table 4. Participants with vocal fatigue divided by total participants in the voice disorders group were calculated as the sensitivity of the VFI-TH, which was 22.7 percent (Table 5).

Table 4 Details of the VFI-TH parts 1 and 3 in the voice disorders group (n=22).

Participants	VFI-TH		Criteria meet cut-off	Vocal fatigue
	Part 1 ≥ 24	Part 3 ≤ 7		
RV01	29	6	Part 1,3	Yes
RV02	14	0	Part 3	No
RV03	2	0	Part 3	No
RV04	5	12	None	No
RV05	24	10	Part 1	No
RV06	15	9	None	No
RV07	24	10	Part 1	No
RV08	26	5	Part 1,3	Yes
RV09	22	12	None	No
RV10	30	6	Part 1,3	Yes
RV11	26	10	Part 1	No
RV12	19	2	Part 3	No
RV13	13	6	Part 3	No
RV14	9	3	Part 3	No
RV15	40	9	Part 1	No
RV16	42	0	Part 1,3	Yes
RV17	12	6	Part 3	No
RV18	25	8	Part 1	No
RV19	30	6	Part 1,3	Yes
RV20	23	9	None	No
RV21	17	6	Part 3	No
RV22	5	4	Part 3	No
Meet criteria	10	13	None=4	Yes=5
Range	2-42	0-12		

Table 5 Cross tabulation between the VFI-TH and the reference standard.

Cross tabulation		Reference standard		Total
		Yes	No	
VFI-TH	Yes	5 (22.7%)	0 (0%)	5
	No	17 (77.3%)	60 (100%)	77
Total		22	60	82

Specificity was calculated in the same way as sensitivity. For this study, it was calculated for sixty individuals with normal voices. It was found that none of the participants had vocal fatigue. The results showed that participants who had no voice disorders also had no concurrent vocal fatigue, as shown in Table 6, because none of the participants met the criteria for parts 1 and 3. Therefore, the ability of the VFI-TH to discriminate against individuals with no vocal fatigue in a normal voice was calculated as 100 percent (Table 5).

Table 6 Details of the VFI-TH parts 1 and 3 in the typical group (n=60).

Participants	VFI-TH		Criteria meet cut-off	Vocal Fatigue	Participants	VFI-TH		Criteria meet cut-off	Vocal fatigue
	Part 1 ≥24	Part 3 ≤7				Part 1 ≥24	Part 3 ≤7		
RN01	10	12	None	No	RN31	4	6	Part 3	No
RN02	9	12	None	No	RN32	2	0	Part 3	No
RN03	5	1	Part 3	No	RN33	14	10	None	No
RN04	0	0	Part 3	No	RN34	19	5	Part 3	No
RN05	29	8	Part 1	No	RN35	9	1	Part 3	No
RN06	17	9	None	No	RN36	23	10	None	No
RN07	33	10	Part 1	No	RN37	22	9	None	No
RN08	15	8	None	No	RN38	0	8	None	No
RN09	19	12	None	No	RN39	4	11	None	No
RN10	0	1	Part 3	No	RN40	2	0	Part 3	No
RN11	6	1	Part 3	No	RN41	26	11	Part 1	No
RN12	14	6	Part 3	No	RN42	10	6	Part 3	No
RN13	12	10	None	No	RN43	9	10	None	No
RN14	7	12	None	No	RN44	23	8	None	No
RN15	13	2	Part 3	No	RN45	6	10	None	No
RN16	13	4	Part 3	No	RN46	18	5	Part 3	No
RN17	7	5	Part 3	No	RN47	1	0	Part 3	No
RN18	13	10	None	No	RN48	0	0	Part 3	No
RN19	18	11	None	No	RN49	3	2	Part 3	No
RN20	5	12	None	No	RN50	2	9	None	No
RN21	0	0	Part 3	No	RN51	0	0	Part 3	No
RN22	0	0	Part 3	No	RN52	16	12	None	No
RN23	6	3	Part 3	No	RN53	8	3	Part 3	No
RN24	5	0	Part 3	No	RN54	2	5	Part 3	No
RN25	8	6	Part 3	No	RN55	8	6	Part 3	No
RN26	10	4	Part 3	No	RN56	27	9	Part 1	No
RN27	12	9	None	No	RN57	29	9	Part 1	No
RN28	17	12	None	No	RN58	11	6	Part 3	No
RN29	18	12	None	No	RN59	26	12	Part 1	No
RN30	25	11	Part 1	No	RN60	4	6	Part 3	No
Meet criteria Range		Part 1 = 7 Part 1 =0-33	Part 3 = 30 Part 3 = 0-12		None = 23		Vocal Fatigue		Yes = 0

Reliability

This study collected data on the same day participants consented to join the study. Reliability was assessed through SPSS (version 28) to analyze internal consistency using Cronbach's Alpha coefficient within a 95% confidence interval. The results showed that VFI-TH parts 1, 2, 3, and total items were .93, .87, .94, and .94, respectively.

Table7 Internal consistency of the VFI-TH (n=82).

VFI-TH	No. of items	Cronbach's α coefficient
Part 1	11	0.93
Part 2	5	0.87
Part 3	3	0.94
Total	19	0.94

*95% confidence interval

Discussion

Validity

Content and face validity

This study emphasizes that the protocol for the cross-cultural translation of the self-reported questionnaire used in this study was Beaton's guidelines.²⁵ The last two steps of the guidelines were reviewed by an expert committee and pretested. The VFI-TH had a content validity tool for use in a clinical setting. Accordingly, this study followed a standardized cross-cultural translation protocol²⁵ that influenced the results.

Sensitivity

The sensitivity of the VFI-TH was 22.7 percent. The low sensitivity of the VFI-TH could have been affected by the following five main factors.

Originally, VFI found that the index could effectively detect vocal fatigue in individuals with a broad range of pathologies concerning the voice, i.e. muscle tension dysphonia, TVC scar, and spasmodic dysphonia. Vocal fatigue was primarily found in hyperfunction causes, i.e. muscle tension dysphonia (MTD) and spasmodic dysphonia. Other studies also found that individuals with these voice disorders often had vocal fatigue.^{22,30-32} Meanwhile, our study mostly included neurological voice problems and TVC paralysis (Table 2). The participants in the voice disorders group had lesions, and we could not recruit patients with MTD or spasmodic dysphonia because of time limitations. Hence, those who did not have pathologies of hyperfunctional voice disorders experienced more vocal fatigue, which is different from the original VFI.¹⁴ This study targeted voice disorders, which might have caused the low sensitivity.

Secondly, individuals tend to compensate for their voice problems to normal when voice problems occur for a more extended period, even though they may still be having voice problems, which might affect vocal fatigue detection. The VFI-TH in this study found that the sensitivity differed from the original³³ and other studies.^{22,30-32} The voice disorders group showed that all participants had chronic voice problems.³⁴ Table 2 shows that 82% of participants experienced voice problems for more than two weeks. Participants might have adapted this dysfunctional voice into daily life usage automatically. Furthermore, the VFI-TH is a self-reporting tool that gives each participant the ability to decide to do the questionnaire themselves. In addition, participants may not be able to recall everything accurately when problems occur for some time.³⁵ In this study, the ability of VFI-TH to detect vocal fatigue after being interpreted was lower.

The third reason was the severity of voice disorders. The voice disorders group had already received medical treatment and/or voice therapy, which meant that their pathologies were already relieved and their voice problems had improved compared to the time they participated in this study. They could have perceived that their voices were better or that they had no voice problems. In such cases, participants might barely detect their vocal fatigue, as reflected in the VFI-TH reports. This effect was agreeable

with Niebudek-Bogusz et al. in 2008,³⁶ which found that receiving voice therapy subjectively improved vocal outcomes as reported.

The fourth reason was a limitation of study time and the COVID-19 pandemic. In this study, we began to recruit participants while COVID-19 was spreading. Hospitals limited the number of patients who could go to the hospital and allowed emergency cases only. Hence, voice disorder patients who had to follow up for voice therapy postponed their appointments for a few months. These two situations limited research time, which affected many voice disorders groups and might have resulted in the low sensitivity of the VFI-TH.

The last factor was the SLP's lack of subjective voice assessment in the inclusion criteria. One of the subjective voice assessment tools usually used in the clinic is GIRBAS³⁷ (i.e., G: grade, I: instability, R: roughness, B: breathiness, A: asthenia, and S: strain). Thus, the lack of SLP voice assessment led to an insufficient number of participants with voice disorders. Participants with minimal voice disorders were recruited with a history of vocal pathologies diagnosed by an ENT doctor instead of being recruited for current voice problems, which might have improved over time.

Even though the VFI-TH for this study had low sensitivity, the SLPs could use it as an additional tool with other voice assessments in the clinic. For more effectiveness, the tool was suggested for patients with hyperfunctional voice disorders such as muscle tension dysphonia and spasmodic dysphonia. Therefore, low sensitivity in this study was influenced by all five factors, as described above.

Specificity

VFI-TH had high specificity to vocal fatigue in the normal group. The original VFI describes that the vocal fatigue score must pass parts 1 and 3 together. In this study, typical voice participants who had voice problems were in the acute phase (<2wk) (Table 2), which was agreeable with other studies which concluded that voice problems could occur in most people in a lifetime.³⁸⁻⁴⁰ In the meantime, participants who joined this study experienced minimal voice problems that did not affect daily life or work. Besides, it was found that participants with normal voices who passed part 1 totaled seven and part 3 totaled 30, but none passed both parts 1 and 3 (Table 6). As described, the specificity of this study was 100 because we could not find participants who passed both parts 1 and 3. However, the VFI-TH can distinguish vocal fatigue among those with normal voices at risk of voice problems.

Reliability

The results show that the VFI-TH parts 1, 2, and 3 total items were .93, .87, .94, and .94, respectively. Interpreting a reliable level was acceptable.^{41,42} Moreover, the reliability of parts 1 (.93) and 3 (.94) were agreeable with the original VFI¹⁴ and other versions such as German,¹⁶ Malayalam,¹⁸ Tamil,¹⁷ Hong Kong-Chinese,²¹ Persian¹⁹ and Croatian.²² In contrast, Cronbach's α coefficient in part 2 might impact participants' confusion while scoring each item in part 2 with Thai words that may be difficult to understand. Even if the reliability of part 2 (.87) was not in agreement with other versions of the VFI, the value was accepted. Acceptable

reliability might be attributable to the use of a standard reliability process.

Conclusion

The VFI-TH has 19 items divided into three parts. Part 1 is related to the tiredness of the voice and avoidance of voice use. Part 2 is related to physical discomfort, while part 3 is associated with improving symptoms due to rest. The cut-off score for each part is different. The cut-off scores are ≥ 24 for part 1, ≥ 7 for part 2, and ≤ 7 for part 3. Individuals with vocal fatigue should meet the criteria for both parts 1 and 3. In clinical use, an SLP should clearly explain to individuals about the negative and positive words used in each part as follows: VFI-TH parts 1 and 2 use negative words. The higher the score, the higher the degree of voice problems. In contrast, part 3 uses a positive word. The lower the score, the higher the degree of voice problems. If the explanation is not clear enough, individuals might be confused and the test results might be misinterpreted. The VFI-TH was a valid and reliable tool. Sensitivity was 22.7%, and specificity was 100%. The VFI-TH can also be used with other voice assessments.

Limitations

In this study, data collection was carried out during the pandemic period of COVID-19, which could have affected the number of participants in the voice disorders group due to the low number of hospital visits and low yield in the number of patients with vocal cord lesions, muscle tension dysphonia, and hyperfunctional voice disorders, which ultimately could have affected the sensitivity of the study. The onset of the disease varied in the time range. This variation may have been due to the decreased self-awareness of individuals when reporting their vocal problems. Further research should be conducted concerning these factors.

Conflicts of interest

The authors declare that no competing interests existed at the time of publication.

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