

ADAPTED AIR FLOW AND PHONIC COEFFICIENTS OF FUTURE VOICE PROFESSIONALS

Fluxo aéreo adaptado e coeficientes fônicos de futuros profissionais da voz

Carla Aparecida Cielo ⁽¹⁾, Mara Keli Christmann ⁽²⁾, Talita Marin Scherer⁽³⁾, Carla Franco Hoffmann⁽⁴⁾

ABSTRACT

Purpose: to verify and correlate adapted air flow (AAF), simple phonic coefficient (SPC) and composed phonic coefficient (CPC) in young adult future voice professionals of both genders which have normal voice as well as verifying frequency of sexes. **Methods:** 62 subjects between 18 and 35 years old (12 men, mean 24,25 years old and 50 women, mean 21,42 years old); vocal evaluation by means of the RASATI scale with Kappa reliability coefficient; collecting of the maximum phonation time (MPT) of /a,i,u,s,z/, counting of numbers, vital capacity and AAF; calculation of the SPC and CPC; *Spearman* test for correlations between variables and binomial test for the proportions of normal, diminished and increased values. **Results:** majority significantly feminine presented SPC and CPC normal, and FAA normal and increased when compared to the diminished values. Majority significantly masculine presented SPC normal and increased, when compared to the diminished values; normal CPC and no statistically meaningful difference on AAF. There was moderate positive correlation between SPC and CPC for both genders. **Conclusion:** majority significantly of the studied future voice professionals presented SPC and CPC normal with moderate positive correlation between these measurements. Majority significantly feminine obtained normal results AAF when compared increased values and AAF did not have correlation with SPC and CPC. Majority significantly of the group of future voice professionals was women.

KEYWORDS: Voice; Phonation; Voice Quality; Larynx; Occupational Health

■ INTRODUCTION

The communication is getting even more important role in the labor market, especially for the professionals who depend on it as a main instrument of their profession. In this context, teachers, actors, singers, receptionists, telemarketers, lawyers, ministers, health professionals, among others¹⁻⁵.

For a satisfactory communication, voice needs to present acceptable quality by the listener, as it is

fundamental in social relations, as well as an integral part of people overall health. Still, as shown in the literature, there is a positive correlation between voice quality and quality of life²⁻⁶.

Thus, it is important to detect early voice disorders in a future voice professional, because they are a group of risk for developing dysphonia^{3,5,7-11}. The evaluation is the starting point for the detection of voice disorders and its importance is maintained throughout the treatment/melioration as a way to verify the changes of vocal behavior, ensuring the adequate time for the dischargement¹²⁻¹⁵.

Breathing is considered the activator of voice and any problem at this level may have a direct effect on speech and voice, in the aspects of amplitude, frequency and quality⁷⁻⁹. Evidences of respiratory dynamics aim to verify individual breathing capacity, the glottal efficiency, utilization and coordination of breathing out during phonation^{7,15,16}. Among such evidences, it is highlighted the Adapted

⁽¹⁾ Departamento de Fonoaudiologia da Universidade Federal de Santa Maria, Santa Maria, RS, Brasil.

⁽²⁾ Universidade Federal de Santa Maria, Santa Maria, RS, Brasil.

⁽³⁾ Laboratório de Voz da Universidade Federal de Santa Maria, Santa Maria, RS, Brasil.

⁽⁴⁾ Universidade Federal de Santa Maria, Santa Maria, RS, Brasil.

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Airflow(AA), the Simple Phonic Coefficient (SPC), and Composite Phonic Coefficient (CPC), in order to assess the coordination between breathing out and glottal vibration during phonation².

It is affirmed the importance of the use of these measures in speech clinic because they are easy to perform, inexpensive, they provide more objective data, and by allow the monitoring of patient progress throughout the therapeutic process or vocal improvement^{2,16}. However, it was found lack of scientific studies in the literature with AA, SPC and CPC measures in different populations and aged groups.

Thus, the present study aimed to verify and correlate the AA, SPC and CPC of young adults of both gender, without vocal changes, future voice professional, and to check the frequency of the gender.

■ METHODS

Analytical cross-sectional observational study, quantitative and contemporary feature. Target population consisting of subjects who sought speech medical-school to make improvements or vocal assessment, from July 2009 to July 2010. The study group was formed based on the criteria described as follow.

Inclusion criteria: accession to the Free and Enlighten Consent Form (FECF); student of a course which the future profession would require professional use of voice^{11,17}; aged between 18 and 40, avoiding the vocal changes from adolescence, and the hormonal and structural changes of aging; normal auditory thresholds^{2,15,18-21}, and average degree of zero to 0.9 in the aspects evaluated by RASATI scale^{2,12,15}.

Exclusion criteria: history of neurological, endocrine, psychiatric, gastric and respiratory diseases for the performance or understanding during the evaluations were not affected^{15,19,20}; changing in stomatognathic system that could limit the articulation of emissions required in the evaluations^{15,19-21}; flu and/or respiratory allergies^{2,15,19,20} and/or hormonal changes typical of pregnancy or menstruation and premenstrual periods on evaluations day; having done previous speech therapy and/or otorhinolaryngological treatments^{9,18-20}, or sing in choirs, to avoid that the subject had already trained coordination pneumophonoarticulatory^{19,20,22}.

Among the evaluations, for applying the criteria of inclusion and exclusion, audiometric screening was performed in an acoustically treated booth(Fonix, model FA-12, type I) and evaluation of the stomatognathic system, in which were analyzed

tension, posture and mobility of structures and its functions^{11,12,15,19}.

Voice auditory perceptual assessment was performed by RASATI scale^{2,23}. For the study, it was established, as a criterion for normal voice, the average degree of 0.9 maximum on the aspects evaluated by the scale¹². It was used Zoom H4n professional digital recorder with stereo unidirectional microphone (96KHz, 16bit), placed four centimeters from mouth at 90°^{12,20,24}. The recordings were performed at a room where the ambient noise was below 50dB NPS, measured using digital level sound pressure measurer *Instrutherm* Dec-480^{2,24,25}.

Three judges underwent voice analysis independently, by the maximum phonation time (MPT) of the vowel /a/ of each subject of the target population. The voices of the subjects were presented without identification, randomly arranged, with replication for subsequent calculation of the concordance. The judges were also blinded as to the research objectives and the type of population^{18,23,24}. This evaluation rated the voices as normal or altered glottic level and it was considered as an inclusion criterion, since it was not possible to make the otorhinolaryngological evaluation in all subjects^{7,12,15,18,23}.

It was performed the Kappa coefficient for each of RASATI parameters and to the average value of each judge, gathering the average coefficient from inter and intra evaluation. To judge one, the average Kappa coefficient was 0.7; judge two it was 0.68 and judge three 0.71. The first and second judges had inter concordance of 0.66; the judges one and three of 0.68 and judges two and three 0.62.

From the 86 subjects of the target population, 24 were excluded (one for hearing loss; five under 18 years old, and 18 for middle grade upper to 0.9 in RASATI items). Thus, the study group was composed of 62 future voice professional, among which 12 men between 20 and 35 years old (mean 24.25), and 50 women between 18 and 29 years old (mean 21.42).

For data collection, timed up the MPT phonemes [a:], [i:], [u:], [i:], [z:], and counting numbers after deep inspiration, *in loudness, pitch, quality, and habitual speech speed, in orthostatic position*^{7,18}. Each of the MPT was performed three times, and it was considered the higher of the three values^{12,20,24-27}.

The vital capacity (VC) was obtained with the subjects in orthostatic position, by performing maximum inspiration and, soon after, maximal expiration in dry spirometer Fami-lta®, positioned at the height of the patient. The procedure was repeated three times with nasal occlusion and three times without nasal occlusion^{2,16}. The value of VC used for the calculation of SPC and CPC was the highest value obtained from these six gathering^{2,16}.

The calculation of SPC was conducted by dividing the VC by MPT /a/. The normal range for females is between 105 and 256 ml/s and for males between 90 and 260 ml/s. Higher values indicate large air flow and short MPT, while lower values reflect transglottic reduced airflow, which suggests extensive laryngeal constriction².

The CPC is obtained dividing the VC by of the average MPT /a, i, u, s, z/ and counting numbers¹⁶. It enables to evaluate the vocal behavior in connected speech, expecting smaller values than the values obtained on SPC. The same normal ranges of SPC are used².

AA indicates approximately the air consumption during phonation. The subject emits the vowel /u:/ in the spirometer mouthpiece with usual *loudness*, *pitch* and vocal quality extending the emission, while it is timed and it is annotated the ml reached by the piston of the device. Subsequently, it is divided the amount in ml by the time supported. Considered values as normal values between 80 ml/s to 200 ml/s².

The study was approved by the Research Ethics Committee from the source institution (016945/2010-76).

After being tested the normality of variables (*Lilliefords*), it was chosen the Spearman test for

correlations between AA, SPC and CPC. To compare the proportions of normal results, decreased and increased from AA, CPC and SPC, it was used the binomial test. The significance level used was 5% ($p \leq 0.05$).

■ RESULTS

In Tables 1, 2 and 3, it is verified that the most significant majority of females presented normal SPC and CPC when compared to decreased values. Also, it showed increased value of SPC and CPC and normal and increased AA when compared to the decreased values.

Tables 1 to 3 also show that significant majority of the males had normal and increased SPC, when compared to decreased values; normal CPC, when compared to reduced and increased values; and AA without significant difference.

Regarding the correlations between the SPC, CPC and AA variables listed in Table 4, it is observed that there was a moderate positive correlation between the SPC and CPC (0.001) for both genders.

Table 5 shows that the significant majority of subjects was composed of women.

Table 1 - Difference between normal values, increased and decreased for Simple Phonic Coefficient in both sexes

Female		p-value
Decreased values n (%) 0 (0,0)	Normal values n (%) 42 (84,0)	0,0001*
Decreased values 0 (0,0)	Increased values 8 (16,0)	0,208
Normal values 42 (84,0)	Increased values 8 (16,0)	0,0002*
Male		p-value
Decreased values 0 (0,0)	Normal values 8 (66,7)	0,0001*
Decreased values 0 (0,0)	Increased values 4 (33,3)	0,0005*
Normal values 8 (66,7)	Increased values 4 (33,3)	0,299

Binomial test

* statistically significant values

Table 2 - Difference between normal values, increased and decreased for Composite Phonic Coefficient in both sexes

Female		p-value
Decreased values n (%)	Normal values n (%)	0,0001*
1 (2,0)	45 (90,0)	
Decreased values	Increased values	0,628
1 (2,0)	4 (8,0)	
Normal values	Increased values	0,0001*
45 (90,0)	4 (8,0)	
Male		p-value
Decreased values	Normal values	0,0051*
0 (0,0)	11 (91,6)	
Decreased values	Increased values	0,570
0 (0,0)	1 (8,4)	
Normal values	Increased values	0,0008*
11 (91,6)	1 (8,4)	

Teste Binomial

* statistically significant values

Table 3 - Difference between normal values, increased and decreased for Adapted Airflow in both sexes.

Female		p- value
Decreased values n (%)	Normal values n (%)	0,0001*
2 (4,0)	26 (52,0)	
Decreased values	Increased values	0,0001*
2 (4,0)	22 (44,0)	
Normal values	Increased values	0,628
26 (52,0)	22 (44,0)	
Male		p- value
Decreased values n(%)	Normal values n(%)	0,202
1 (8,3)	6 (50,0)	
Decreased values	Increased values	0,282
1 (8,3)	5 (41,6)	
Normal values	Increased values	0,583
6 (50,0)	5 (41,6)	

Teste Binomial

* statistically significant values.

Table 4 - Correlation between the variables Adapted Airflow, Simple Phonic Coefficient and Composite Phonic Coefficient

	CFS	
	R	p- value
CFC	0,673	0,001*
FAA	0,211	0,099
	CFC	
	R	p- value
FAA	0,218	0,089

Spearman test

* statistically significant values

Table 5 - Comparison of two proportions of gender

Sexo		p- value
Female n (%)	Male n (%)	
50 (80,6)	12 (19,3)	0,001*

Binomial Test

*statistically significant values

■ DISCUSSION

The balance of the inter-temporal relationship between the breathing level, with the flow and expiratory airway pressure; phonation level, with adduction and vocal fold vibration; and the articulation and resonant level, with the changes of the vocal tract, is a result of a proper pneumophono-articulatory coordination. The emission balanced or coordinated transmits stability, self-control and harmony to the listener and encourages greater vocal resistance^{2,15,20,25,28}, important qualities for voice professionals.

The pneumophonoarticulatory coordination can be investigated by the use of procedures and calculations that provide information about the interaction between the three levels involved in voice production (respiratory, phonation and articulatory/resonant), as in the case of SPC and CPC and AA².

In the present study, the significant majority of females from the group of future voice professional showed normal SPC (Table 1) and CPC (Table 2) and normal and increased AA (Table 3), in comparison with the decreased values. The most significant male presented normal and enlarged SPC, in comparison to decreased values; normal CPC and no significant difference AA.

For such measures, higher values in relation to normality can be found in cases of glottal closure or vocal fold paralysis by increasing transglottic flow resulting from insufficient coaptation of the vocal folds. In opposition, lower values reflect transglottic reduced airflow with large laryngeal constriction. Both situations create pneumophonoarticulatory incoordination^{2,29}.

In this study, the subjects showed no suggestive vocal quality of air leakage and its increased measures, when compared to the decreased values, suggesting wispy control of the progressive relaxation of the respiratory muscles, reducing the MPT not because the air leaking by the glottic level by glottic insufficiency, but yes, by difficulty in breathing control level, also featuring a pneumophonoarticulatory incoordination that can harm their professional vocal performance.

Although the age group differ from the present study, the results of SPC and CPC obtained are in agreement with the only study found in the literature review on phonics coefficients, in which the average CPC of the elderly group studied was 184.35 ml/s for males and 186.93 ml/s for females, within the expected range for the adult population²⁹.

The subjects of this study showed significant results of SPC and CPC within normality, possibly due to the fact it is a vocal group without increased vocal demand and with normal voice. Furthermore, it must be considered the fact that the normal range of these coefficients is relatively large, with a few research on such measures².

A study showed the occurrence of increased pneumophonoarticulatory incoordination, as increased vocal demands, proved through evaluation of subjects at different times during the training course for professional voice users, but using the relationship s/z^{21} . In this case, the risk interference is evident that the future voice professional are exposed when start their professional activities without adequate preparation for the use of professional voice, may developing laryngeal organofunctional disorders^{1-3,6,7,21}.

It is also important to compare the results above and below the normal range to indicate specific situations related to the imbalance between the three levels of vocal production, as mentioned earlier and that, in turn, require targeted therapeutic approaches^{2,29}.

The significance of moderate positive correlation between SPC and CPC variables (Table 4) corroborates the fact that both coefficients are proposed to assess the interaction between the vocal levels production^{2,29}.

The AA variable was not correlated to SPC and CPC. It is possible that the fact that the VC measurement alone includes maximum inhalation and exhalation had favored the correlation between the coefficients, which did not happened on AA, whose collection does not use deep inspiration². Still, the calculation of the coefficients use measures of VC and MPT collected separately, at different times, and the calculation of AA uses the measurement

of expiratory air flow in ml during vocal emission which is measured at the same time, in the same occasion².

No studies were found in the literature referring to the AA measure for comparison and discussion of the results of this work, however it can be suggested that the AA is a complementary measure to the phonic coefficients, since their results, in females, were approached to the coefficients results. In males, there was no statistical significance, possibly due to being a small group.

Regarding the frequency of genders, a significant majority of the study group (Table 5) was composed of women, in agreement to other studies involving professionals and future professionals and indicating the predominance of female gender^{1,10}.

Vocal disorders may be linked to occupational activity and directly influence in the professional and social life of the subject, harming the professional activities of those who depends on the voice to perform their profession¹. The findings in this work show that subjects, even without great vocal demand and normal voice, presented some results outside the normal range, suggesting pneumophonoarticulatory

incoordination. Thus, subjects previous assessment and vocal preparation, including the training of pneumophonoarticulatory coordination, before the start of the professional voice use, may minimize the occurrence of behavioral dysphonia or organo-functional caused by pneumophonoarticulatory incoordination.

Due to the ease of use of the measures studied in the speech clinic; your chance of quantification, which allows more objective assessment and monitoring of patients; and the scientific research literature gap on them, more studies are needed.

■ CONCLUSION

The most significant of the future voice professional studied showed normal values of SPC and CPC, and there was a moderate positive correlation between these measures. AA with normal and increased results was significant only in females and showed no correlation with SPC and CPC. The most significant of the group of future voice professional was composed by women.

RESUMO

Objetivo: verificar e correlacionar o fluxo aéreo adaptado (FAA), coeficiente fônico simples (CFS) e coeficiente fônico composto (CFC) de adultos jovens de ambos os sexos, sem alterações vocais, futuros profissionais da voz, e verificar a frequência dos sexos. **Métodos:** 62 sujeitos entre 18 e 35 anos (12 homens, média 24,25 anos e 50 mulheres, média 21,42 anos); avaliação vocal pela escala RASATI com coeficiente de confiabilidade Kappa; coleta dos tempos máximos de fonação (TMF) de /a,i,u,s,z/, contagem de números, capacidade vital e FAA; cálculo dos CFS e CFC; teste de *Spearman* para as correlações entre as variáveis e teste binomial para proporções de valores normais, diminuídos e aumentados. **Resultados:** a maioria significativa feminina apresentou CFS e CFC normais, e FAA normal e aumentado, em comparação aos valores diminuídos. A maioria significativa masculina apresentou CFS normal e aumentado, em comparação aos valores diminuídos; CFC normal e FAA sem diferença estatisticamente significativa. Houve correlação positiva moderada entre o CFS e o CFC para ambos os sexos. **Conclusão:** a maioria significativa dos futuros profissionais da voz estudados apresentou CFS e CFC normais e com correlação positiva moderada. A maioria significativa feminina obteve resultados de FAA normais e aumentados, em comparação aos valores diminuídos, e o FAA não apresentou correlação com CFS e CFC. A maioria significativa do grupo de futuros profissionais da voz foi composta por mulheres.

DESCRITORES: Voz; Fonação; Qualidade da Voz; Laringe; Saúde do Trabalhador

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Mailing address:

Carla Aparecida Cielo

Rua Pedro Londero, 155

Santa Maria – RS

CEP: 97095-530

E-mail: cieloca@yahoo.com.br