

# Perceptual-Auditory and Acoustical Analysis of the Voices of Transgender Women

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**Summary:** Voice is an important gender marker in the transition process as a transgender individual accepts a new gender identity. The objectives of this study were to describe and relate aspects of a perceptual-auditory analysis and the fundamental frequency (F0) of male-to-female (MtF) transsexual individuals. A case-control study was carried out with individuals aged 19–52 years who attended the Gender Identity Program of the Hospital de Clínicas of Porto Alegre. Vocal recordings from the MtF transgender and cisgender individuals (vowel /a:/ and six phrases of Consensus Auditory Perceptual Evaluation Voice [CAPE-V]) were edited and randomly coded before storage in a Dropbox folder. The voices (vowel /a:/) were analyzed by consensus on the same day by two judge speech therapists who had more than 10 years of experience in the voice area using the GRBASI perceptual-auditory vocal evaluation scale. Acoustic analysis of the voices was performed using the advanced Multi-Dimensional Voice Program software. The resonance focus and the degrees of masculinity and femininity for each voice recording were determined by listening to the CAPE-V phrases, for the same judges. There were significant differences between the groups regarding a greater frequency of subjects with F0 between 80 and 150 Hz ( $P = 0.003$ ), and a greater frequency of hypernasal resonant focus ( $P < 0.001$ ) in the MtF cases and greater frequency of subjects with absence of roughness ( $P = 0.031$ ) in the control group. The MtF group of individuals showed altered vertical resonant focus, more masculine voices, and lower fundamental frequencies. The control group showed a significant absence of roughness.

**Key Words:** Transgender people–Voice–Brazil–Transsexual–Voice Quality.

## INTRODUCTION

Gender dysphoria (GD) is a marked incongruence between one's experienced gender and one's assigned gender, resulting in a strong and persistent desire to belong to the other gender by hormone therapy, speech therapy, or surgical procedures.<sup>1</sup>

In general, transgender women desire a tone of voice consistent with their appearance.<sup>2</sup> Cisgender women have a higher fundamental frequency (F0) than cisgender men.<sup>3</sup> The expected F0 for the female voice in Brazil varies between 150 and 250 Hz.<sup>4</sup> However, the F0 of the cis masculine voice has been reported as between 100 and 150 Hz,<sup>5</sup> 80 and 150 Hz,<sup>6</sup> and 110

and 146.7 Hz.<sup>7</sup> In addition, other aspects of human communication, such as semantics, pragmatics, intonation, sound pressure level, and voice resonance, are relevant to the recognition of a female voice.

A study<sup>8</sup> aiming to quantify the perception of gender in telephone communication found that female transgender voices were perceived as more masculine than female cis voices. Only the voices of seven transgender women were recognized as female.<sup>8</sup> Transgender women tend to work their voice to raise their F0 through natural compensation, surgery, or speech therapy.

Changes in vocal resonance characteristics may contribute to the perception of femininity in the voices of transgender women.<sup>9,10</sup> In cisgender women, the formant frequencies are on average 20% higher than those of men<sup>11</sup> as a consequence of differences in anatomy (smaller resonance cavities and forward tongue carriage in women), ways of speaking, lip spreading, and smile formation.<sup>9</sup> The importance of oral resonance characteristics for gender identification is still not entirely clear. A study including 10 transgender women demonstrated that therapy targeting lip spreading and forward tongue carriage results in resonance characteristics that more closely approximate that of cisgender women.<sup>9</sup> Furthermore, analyzing 15 transgender women demonstrated that subjects with voices perceived as more female had vowel frequencies higher than those voices perceived as more masculine.<sup>10</sup>

One study examined the usefulness of phonetograms and aerodynamic measures for voice assessment of 25 male-to-female (MtF) transsexual individuals.<sup>12</sup> The results showed that breathiness is not significantly related to gender classification; the importance of F0 in gender perception was confirmed, and the speech sound pressure level was higher than the normal patterns of cisgender women.<sup>12</sup> The authors concluded that the

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Time of the study: January 2015 and July 2016.

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evaluated tools are important for visual feedback and documentation of changes in the vocal therapy of transgender people. In addition, the lower level of speech sound pressure may contribute to the feminization of transgender women voices.<sup>12</sup>

The GRBASI scale is based on the auditory perception of a trained therapist and relies on previously standardized assessment scales.<sup>13</sup> The scale is used internationally as a simple method to assess the overall degree of dysphonia (G). The evaluator identifies four independent aspects: roughness (R), breathiness (B), asthenia (A), and strain (S), which is considered most important in the definition of a dysphonic voice. Subsequently, the authors<sup>14</sup> added instability (I), which represents the fluctuation in vocal quality. The evaluator should establish a four-point scale, helping to identify the degree of each deviation of each of the factors (0 = normal or absent, 1 = mild, 2 = moderate, and 3 = severe). Such perceptual analysis is a subjective method because it depends on the judgment of one or more evaluators. This subjectivity still generates discussions among speech therapists; however, the contributions of the GRBASI scale to scientific evidence and clinical practice is indisputable.<sup>15</sup>

In contrast, acoustic analysis is an objective, noninvasive approach that allows for the integration of perceptual-auditory evaluation data with the physiological plane. It details the process of generating the sound signal and provides an indirect estimate of the vocal fold vibratory patterns to determine the individual's F0.<sup>16,17</sup>

The perceptual-auditory and vocal acoustic characteristics of the female transsexual individual associated with the perceptual evaluation of masculinity and femininity and the characteristics of the focus of resonance are not yet fully known. The present article aimed to describe and associate aspects of perceptual-auditory analysis and the F0 of the voices of transgender women.

## METHODS

### Design overview

This is a prospective case-control study.

### Setting and participants

The institution's ethics committee approved this study (number 14075). All participants were informed regarding the procedure

and signed the informed consent prior to participating in the research, according to Resolution 466/12 from the National Commission of Ethics in Research. The sample comprised 58 transgender women and 28 cisgender women recruited between January 2015 and July 2016 (Figure 1).

All transgender persons fulfilled the criteria for GD according to the DSM-5 criterion and were diagnosed by a specialized physician. The individuals diagnosed with GD attended both group and individual medical appointments on a biweekly basis in a GD outpatient clinic at the Hospital de Clínicas de Porto Alegre.

All transgender women included in this study had at least 2 years of experience as a woman and 1 year of hormonal therapy. Adolescents were excluded due to changes in vocal characteristics (DeCS, 2016), and subjects older than 55 years old were excluded on account of pronounced age alterations in their voices. Additional exclusion criteria included self-report of smoking, current use of illicit substances and/or alcoholism, hearing loss, self-report of consultation with a speech therapist or otorhinolaryngological treatment of laryngeal prominence, self-report of diseases that could interfere with efficient vocal production (such as gastroesophageal reflux disease and respiratory problems), or self-report of psychiatric or neurological diseases that could impede the comprehension of the study tasks. All transgender women included were androphiles and did not perform vocal therapy.

The following inclusion criteria were applied for selecting the control group: heterosexual cisgender women using contraceptives, with the aim of standardizing the sample, because the group of subjects also underwent hormonal treatment. We chose to include only heterosexual women because current literature suggests that the voice pitch characteristics, also called F0 features, of lesbians and gay men are shifted from what is typical for straight women and men.<sup>18</sup> Average voice pitch has been found to be lower in straight compared with gay men<sup>19</sup> and higher in straight women compared with lesbians.<sup>20</sup> Hence, we assumed gender-typical masculinity-femininity self-ratings to be reflected in gender-typical patterns of voice pitch characteristics. The same exclusion criteria for the cases were applied in the control group. Differently from the transgender sample, the control group was invited through websites and Facebook.

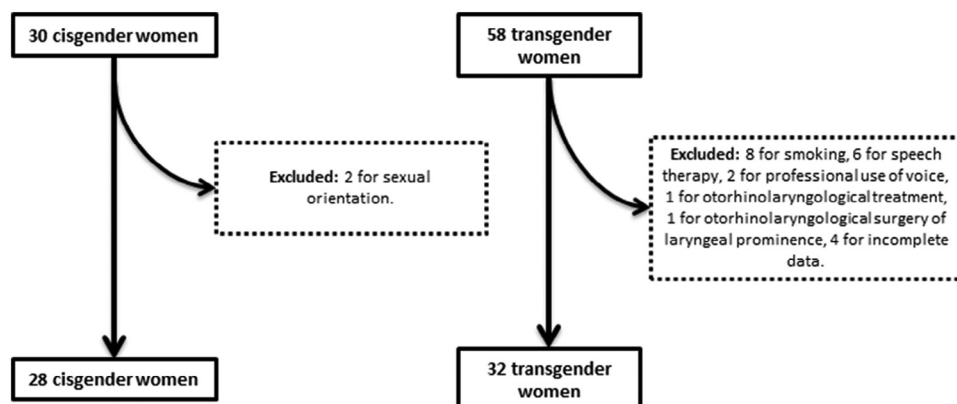


FIGURE 1. Sample composition.

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