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The Efficacy of Gender-Affirming Voice and Communication Therapy – a Systematic Review

Review Title: "Is voice and communication therapy effective in supporting trans and gender non-conforming persons towards attaining greater gender congruence? If so, are specific modes of intervention more likely to increase attainment of this goal?"

Authors: G. Lorimer, B. Rutter.[a]
[a.] Department of Health Sciences, University of Sheffield.

Corresponding Author:
Dr Georgiana Vivienne ffrances Lorimer,
200 Ashburton Road, Hugglescote, Leicestershire, LE67 2HD.
georgielorimer@gmail.com
07790279705

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"Is voice and communication therapy effective in supporting trans and gender non-conforming persons towards attaining greater gender congruence? If so, are specific modes of intervention more likely to increase attainment of this goal?"

Abstract: Background. The WPATH (2022) recommend voice and communication therapy within their standards of care for transgender and gender-diverse individuals, however, there is currently limited data to address the efficacy of interventions for this population beyond changes to fundamental frequencies. This systematic review will explore (1) the efficacy of voice and communication therapy for supporting trans and gender-diverse individuals in decreasing gender incongruence and will (2) consider the most effective modes and models of intervention for attaining this goal.
Study Design. Systematic Review.
Methods. A systematic literature search was undertaken through the online databases Scopus, Cochrane Library, PsycInfo and PubMed, based upon a PICO search strategy, with an additional paper being included from manual citation searches. For inclusion, studies were required to address purely non-surgical interventions, and, to appropriately align with a contemporary understanding of therapeutic efficacy, to include patient self-rating outcome measures alongside acoustic measures.
Results. Eight pertinent studies were included from the searches. The results of all eight studies indicated changes in acoustic measures, listener perceptions and self-perceptions following therapeutic intervention for participants of varying ages and backgrounds.
Conclusions. Voice and communication interventions appear to improve quality of life, vocal function and social participation in transgender and non-binary individuals, and support movements of acoustic and perceptual measures to more closely reflect an individual's gender. Further, much larger studies are required to (1) compare modes and models of intervention, and to (2) assess the efficacy of therapeutic intervention for wider transgender populations.
Key Words: Voice and communication therapy – Transgender – Gender incongruence – Therapeutic efficacy – Voice – Systematic review.

Introduction

Identity is described as being the 'meeting point' between how one perceives one's self and how one is perceived by the persons with whom one comes into contact.[1] When one's self perceptions align with those of wider society, a sense of congruence is maintained. Where these diverge, either due to external perceptions or internal misalignments, a sense of disconnect is formed, which destabilizes the manner in which an individual is able to recognize their intrinsic perceptions of self.[2] One of the primary representations of self and identity is a person's voice.[3] It is reported across many of the populations with which speech and language pathologists (SLPs) work, that changes, diminutions, and losses of speech or communicative abilities have major, long-standing impacts upon a person's sense of self.[4-7] For transgender and gender non-conforming persons, this same disconnect between self-perception and societal realizations of identity can hold additional challenges. Perceived gender divergences can have a major psychological impact for an individual,[8] with the potential to exacerbate feelings of gender incongruence (the preferred term for gender dysphoria included in the International Classification of Diseases (ICD) since 2018),[9] but may also place the individual at a greater risk of violence from other persons.[10] Binary transgender patients who desire to 'blend in' with cisgender people have reported that even if

they are not distinguishable from cisgender persons in terms of appearance, they are frequently demonstrated to be transgender by a voice which does not coincide with their gender expression. This increases their sense of disconnect and encourages them to seek voice therapy.[5] As understanding and acceptance grows, the focus is changing away from a medical and legal encouragement towards 'blending in' with a perceived gender binary (which could move patients towards feelings of further displacement and concealment).[11] Instead, patients are supported towards embracing a sense of identity in which authenticity to their unique perception of self, and the feelings of 'rightness' associated with this, become paramount.[12]

Until recently, SLPs, as with many medical professionals involved in transgender healthcare, have focused upon the 'fixing of problems', following a medical model in their care pathways.[13] This less holistic approach is reflected in the language used in a number of the standard SLP textbooks such as *Greene and Mathieson's The Voice and its Disorders*, which still refers to trans women as 'the male trans-sexual',[14] and in the frequent focus within the wider literature upon surgical interventions, which are now often considered a 'last resort',[12] and upon therapeutic modifications to the fundamental frequency alone (e.g. Aires et al., 2023;[15] Meister et al., 2017;[16] Schwarz et al., 2017;[17] Song & Jiang, 2017;[18] Van Damme, 2017.[19]). As a gender non-conforming individual, Hope has experienced less-effective medical support in their own history, so encourages practitioners to take a person-centered approach in their planning and delivery of care.[9] This is in keeping with renewed interests in a biopsychosocial model across disciplines, as demonstrated through the development of the International Classification of Functioning (ICF).[20] To move towards person-centered care for transgender populations, Mills and Stoneham (2021) state that the view of the gendered voice as a fixed binary, in which patients are directed from a masculine to an ideal feminine voice type, or vice versa, must be challenged. They suggest replacing it with patient-led targets and desired outcomes, which can be formed from supported discussions of the individual's perceptions of their voice and gender expression alongside their individual gender identity.[13] Measures of set targets should reflect the patient's requirements for speech and communication change, across all of the recommended aspects of voice therapy for trans and gender diverse persons that the individual deems pertinent. These include fundamental frequency, voice onset, articulation, resonance, voice quality (e.g. breathy or harsh), prosody, and intonation.[21] Accordingly, as described by Quinn et al. (2022a), to measure effectiveness within individual therapy outcomes and within studies of efficacy, the attainment of a specific modal pitch in conversational speech is less relevant than patient satisfaction and reported reductions in feelings of gender incongruence.[22]

The primary objective of this systematic review is to discover whether voice and communication therapy is effective in supporting transgender and gender diverse individuals towards attaining greater gender congruence and comfort within their own identities. This measure of efficacy will be based upon patient reports of improved quality of life and gender congruence related to voice and communication interventions, via self-report measures such as the Transgender Self-Evaluation Questionnaire (TSEQ) or the Trans Woman Voice Questionnaire (TWVQ). Anecdotal evidence suggests that voice and communication therapy that supports intervention in a range of communicative modes is likely to be effective in enhancing gender congruence and improving quality of life (Mills & Stoneham, 2017).[12] However, in order to accurately demonstrate this efficacy in relation to a self-assessed sense of improved gender congruence, a systematic review of the qualitative data addressing the improvements of voice is required.

A secondary objective is to explore whether there are specific interventions that are reported to be particularly effective in achieving the goals of this patient population, and, if so, to identify and provide information on those perceived as offering the greatest support.

Whilst the focus upon self-assessment to measure efficacy is important for the positioning of patient as an 'expert by experience',[13] to rely entirely upon this approach may be considered controversial, as the recorded information is less quantifiable (Desjardins et al., 2017).[23] However, in order to address the efficacy of voice and communication therapy as a highly nuanced process of change (one that aims to extend beyond the effectiveness of individual interventions and to enable the discovery and attainment of an individualistic experience of gender congruence), it is essential to take an approach that facilitates the patient to choose the specific changes and degree of change necessary to find gender congruence through voice.[9,12] As this is only measurable through a patient's feelings of 'rightness' in their presentation, as described by Stryker (2008),[10] a measure of patient attainment of goals through self-reporting is integral to gauge treatment efficacy.[24]

Methodology

To select and report upon appropriate studies for this systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were utilized.[25] In the selection of studies, online databases were searched to elicit the primary body of results, however, the citations of associated articles were also reviewed to isolate any additional pertinent studies, and one record was included, as is indicated in *Figure 1*.

Search Strategies

A literature search was undertaken on the 22nd of May 2023 using the online research databases Scopus, The Cochrane Library, The American Psychological Association PsycInfo, and PubMed. The search terms used were drawn from the 'population' and 'intervention' sections of a PICO (population, intervention, comparison, outcomes) search strategy. As research into voice and communication therapy for this patient population is still an emerging field, for which there is currently a notable heterogeneity of terminologies and patient-specific language used, the inclusion of the 'comparison' and 'outcome' terms from the PICO search strategy were omitted from the database searches, and were instead implemented manually after collating the database results. The following search terms were used:

1. "gender non-conforming" OR trans* OR transgender OR transsexual OR non-binary OR "gender queer"
   AND
2. voice OR "voice therap*" OR "voice change" OR "speech therap*" OR "communication change"
   AND NOT
3. glottoplasty OR laryngoplasty

In all four database searches, terms one and two were restricted to 'article title'. Term three was approached differently, as the search facilities on the four databases did not all discriminate in the same manner when engaging with a negative search term. Here, and also within the 'Inclusion and Exclusion Criteria', similar and synonymic terms were isolated in order to adjust for these different search procedures, or were implemented manually after the database searches had been made. Therefore, term three was restricted to the article title, abstract and keywords for the Scopus, PsycInfo, and Cochrane Library searches, and was restricted to 'title/abstract' for the PubMed search.

The results from all of the databases were restricted to papers published in the English language between the years of 2003 and 2023. This twenty year timescale was selected to

accommodate for the specificity of the topic whilst reflecting the dramatic increase in research that has accompanied the considerable advances in global beliefs and acceptance with regards to this patient population over the last two decades.[10] As Scopus includes titles from a diverse array of disciplines and fields of study, an additional exclusionary criterion of 'Health Professions' was placed upon the initial search. The database searches predominantly elicited journal articles, however there were also letters, reviews, book chapters, ASHA (American Speech-Language-Hearing Association) information documents, and systematic reviews which were subsequently excluded from the results.

The Screening Process

Following the database searches, additional inclusion and exclusion criteria were implemented for the manual selection of appropriate studies. The screening process for the returned search results is listed below, in *Figure 1*. Whilst other systematic reviews of gender affirming voice support have been made, for example Oles et al. (2022),[26] Schwartz et al. (2017),[17] Song & Jiang (2017),[18] and Van Damme et al. (2017),[19] these almost exclusively address surgical interventions, and few of these include a primary, person-centered requirement for patient ratings as a delineation of therapeutic efficacy. Whilst Leyns et al. (2021) do present a paper that exclusively discusses therapeutic interventions for trans persons, and also include a component that addresses patient satisfaction as an indication of effectiveness, only 70% of their studies include self-assessments, relying instead upon clinician assessments of vocal femininity or external listener perceptions to assess efficacy in the remainder.[24] Although the number of studies in this area is limited, the following inclusion and exclusion criteria remain strict to this specified purpose (inclusion criterion three).

Inclusion criteria

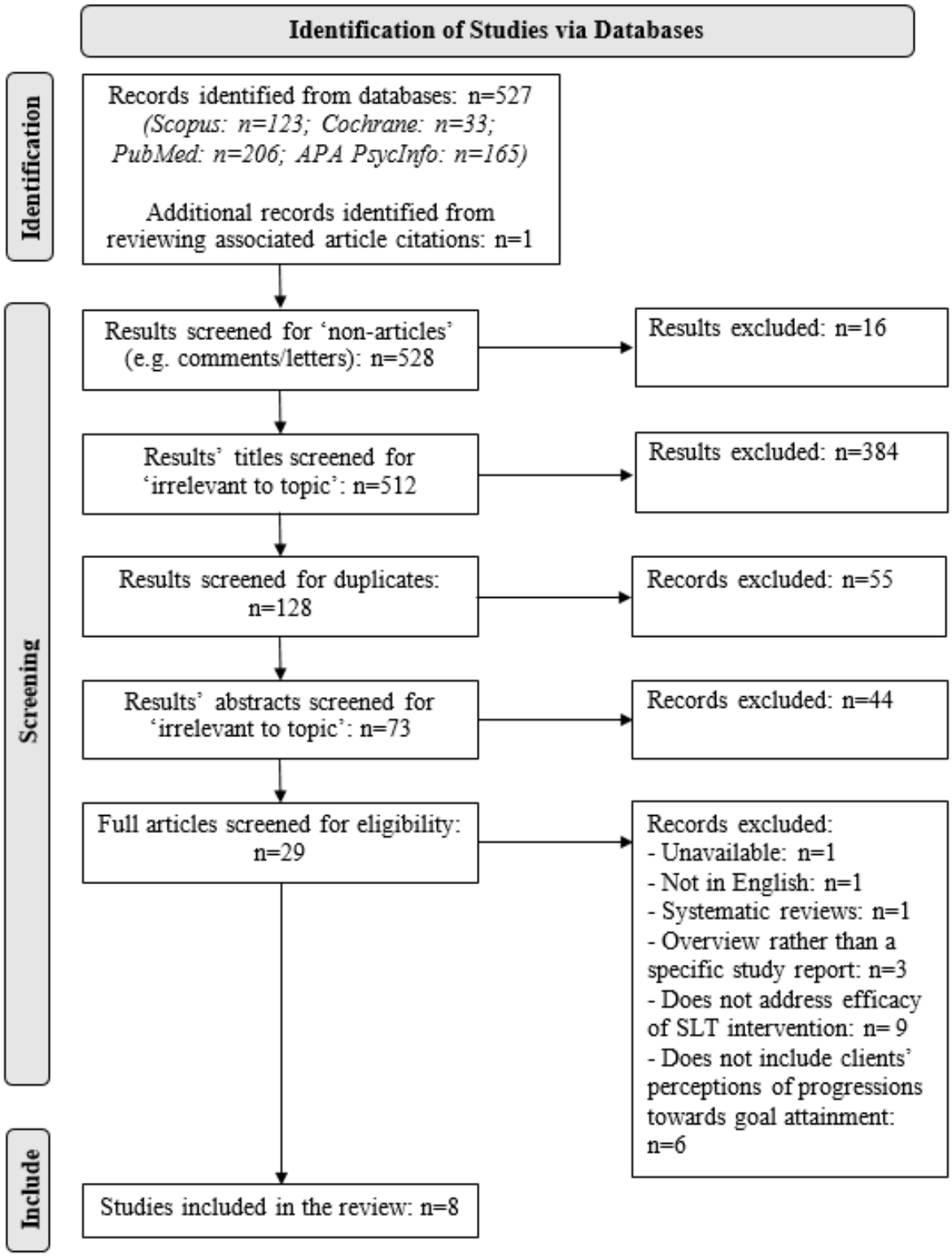
1. Studies must address the use of voice and communication therapy as an aid to reducing gender incongruence.
2. Studies should address the efficacy of voice and communication therapy for the specified patient population.
3. A study's measures for efficacy must include a component of patient-reported measures, self-assessments, or measures of quality of life relating to progress towards attainment of goals, or lack thereof.
4. Studies may be focused upon trans men, trans women, non-binary persons, or any groupings of these patient groups.
5. Studies may use alternatives or permutations of current and past language to reflect an experience of gender incongruence, leading to an individual attempting either social or medical transition to improve or attain gender congruence (e.g. gender non-conforming, transgender, transsexual, dysphoria et c.).
6. Single-case studies may be included.

Exclusion criteria

1. Papers not written in English.
2. Results that are not journal articles reporting on studies (e.g. reviews, letters, book chapters).
3. Previously conducted systematic reviews.
4. Studies in which voice and communication therapy is either presented as an insignificant or a lesser part of a wider program of support to the attainment of gender congruence, to a degree whereby the benefits, or lack thereof, of this therapy type

cannot be assessed. This last criterion will, through necessity, be applied during a full reading of the articles.

Figure 1. Identification of Studies for Inclusion
(Adapted from PRISMA flowchart: Screening and Selection by Page et al.[25])



PROSPERO Registration

To avoid duplication, proposed systematic reviews should be registered with PROSPERO. As this systematic review was initially created for practice rather than publication, registration was not sought prior to the extraction and synthesis of data, eliminating the potential to do so. To ensure that this would not replicate the work of others, database searches and consideration of similar systematic reviews were undertaken.

Extracted Data

From the eight studies selected, the following data was extracted: Study design; study aims; participant population, including population size, ages where available, and gender identities (or clinician-specified equivalents where patient language preferences are unavailable); interventions; outcomes for the selected measures, with specific attention to patient-specified satisfaction and attainment (in accordance with a person-centered approach to supporting this patient base[27]) alongside clinician-directed measures; quality appraisal; recommendations for further interventions; and recommendations for further studies.

Appraisal of Evidence Quality

As the studies involve a mixture of objective acoustic measures and subjective perception measures based within numeric scales (e.g. visual analogue scales (VAS)), a quantitative study checklist has been selected. The selected checklist is based upon a revised form of Jackson et al.'s 2006 Graphical Appraisal Tool for Epidemiological studies, produced by the 'National Institute for Health and Care Excellence' (NICE) in the UK, as 'Appendix F: Quality appraisal checklist – quantitative intervention studies' within their Methods for the development of NICE public health guidance.[28] To accommodate for the small scale studies and subjective measures included within this review, this has been further modified to only include the following sections: 1, 2.2, 2.4, 2.9, 3.1, 3.4, 3.6, 4.3, 4.4, 4.5, 4.6, and 5.

Data Synthesis

To effectively synthesize and report upon the extracted data, the information has been organized according to the type of data reported. Thus, for quantitative data, patient self-reported measures and acoustic measures have been collated into two separate tables. These two data sets are individually discussed, with listener and clinician perceptual data related independently in a narrative form. The decisions that have been made for the synthesis and reporting of data have been made to aid clarity in the withdrawal of information from an array of disparate sources, as recommended by Gregory and Denniss (2018).[29]

Results

Evidence Body

The searches of four databases initially produced 527 papers. An additional paper was included from separate bibliographic searches, and a process of discriminatory inclusion and exclusion criteria were manually implemented to reduce the papers to those that specifically address the given title. This has resulted in eight papers, which include a clinical case study, a retrospective cohort study, a retrospective chart review, a non-randomized control trial, a quasi-experimental non-randomized trial, a single-subject changing criterion study, and two experimental single-subject studies. A full summary is given in *Table 1*, including: design and aims; population details including size, mean age, genders and location where available; a brief overview of the interventions used and of the resultant findings; recommendations for further research or researchers in this field; and the quality ratings for the individual studies.

Table 1. Summary of Studies

Study	Study design and aims	Population	Intervention	Subsequent proposals
Study 1 Carew et al., 2007.[30]	Clinical case study. Aims: assess the effectiveness of oral resonance therapy for increasing the perceived 'femininity' of voices in trans women.	10 trans women. Mean age: 40 years (range of 25-64 years). Location: Melbourne, Australia.	Five week program of weekly, 45 minute sessions of modified oral resonance therapy (Boone, 1977;[31] Martin & Darnley, 1992[32]) with an increased focus upon lip spreading and the advancement of tongue position during connected speech.	Larger studies are required to assess relationships between changes in oral resonance and between fundamental frequency and the perception of femininity.
Study 2 Chadwick et al., 2022.[33]	Retrospective cohort study. Aims: assess the efficacy of behavioral training in speech and language therapy for trans women.	16 trans women (13 completed intervention). Mean age: 31.5 years. Location: New York, USA.	Twelve week program of SLP-led behavioral training, either in-person or as telehealth, focusing upon individualized gender-affirming voice and communication modification.	All further studies should assess both acoustic measures and voice satisfaction as the correlation between these has not yet been established.
Study 3 Hancock & Helenius, 2012.[34]	Single case study. Aims: address the lack of research into voice and communication therapy for trans adolescents, and describe and assess efficacy of therapy for this population.	1 trans woman. Age: 15 years. Location: Washington D.C., USA.	Seven month program of fifteen voice therapy sessions covering: Education, posture, tension and breath; oral resonance; intonation; pitch; voice quality; speech rate; and maintaining voice within everyday speech.	Studies asking if therapy in adolescence brings greater results. Cohort and larger studies are required and should include patient perceptions of Quality of Life (QoL) and voice.
Study 4 Hawley & Hancock, 2021.[35]	Single-subject changing criterion design. Aims: assess the effectiveness of voice therapy for trans women, delivered by SLP with a supportive home practice aid.	4 trans women. Mean age: 52.25 years. Location: USA, region unspecified.	Ten/eleven weeks of weekly, 30 minute individual clinic sessions (oral resonance, articulation, SFF, breath and laryngeal control, voice quality) with home exercises (laryngeal massage and twice daily exercises using individual aids and *Voice Analyst App*).	Studies to assess naturalization of elevated SFF, and including removal of telephone aid to assess efficacy. Studies should explore a more diverse range of ages and genders.

Study 5 Merrick et al., 2022.[36]	Retrospective Chart Review. Aims: compare the effectiveness of a hybrid (individual and group) voice training model and an individual voice training model for trans individuals.	60 trans women and 2 non-binary persons. Mean age: 38.1 years (hybrid) and 35.5 years (individual). Location: Toronto, Canada.	Ten week program of voice feminization therapy in either an individual or hybrid model. This included voice production and vocal hygiene; breath work; resonance; pitch; inflection and articulation; and nonverbal communication.	Trans researchers should be involved in future studies. Studies that include larger participant groups and do not follow a retrospective design would be beneficial.
Study 6 Mészáros et al., 2005.[37]	Non-randomized control trial. Aims: assess the efficacy of trans voice therapy, whether this reduces need for glottoplasty, and if early intervention reduces dysphoria.	5 trans individuals (amab), (treatment – 3; control – 2, split). Mean age: 22 years (20-26). Location: Budapest, Hungary.	Program of weekly therapy for an average of 9.6 months, focused upon SFF through pitch elevation, articulation, resonance, breathing, reduction of laryngeal muscle tension, and the introduction of 'soft tone' and more feminine intonation patterns.	Conservative voice therapy is recommended for this patient group, with early intervention acting as a bridge or substitute for those seeking glottoplasty.
Study 7 Quinn et al., 2022b.[38]	Quasi-experimental, non-randomized trial. Aims: compare the efficacy of voice therapy delivered in different degrees of intensity.	34 transfeminine individuals (amab). Mean age: 31 years (intensive); 33 years (traditional). Location: Melbourne, Australia.	Twelve, 45 minute sessions of voice therapy, spread weekly over twelve weeks for the traditional group and thrice weekly over four weeks for the intensive group. Therapy included behavioral training in vocal health and production, breath, pitch, and resonance.	Future studies should include a larger, more diverse participant base, randomization, clearer parameters, and patient identities and goals.
Study 8 Quinn & Swain, 2018.[39]	Experimental single-subject study. Aims: assess the efficacy of an intensive model of voice feminization therapy for a transgender young offender.	1 transgender individual engaging in voice feminization. Age: 17 years. Location: Victoria, Australia.	Two week program of twice daily, 60 minute voice therapy sessions involving vocal health/flexibility; pitch (Stemple VFE);[40] oral resonance (Lessac-Madsen RVT);[41] and voice education. Between session practices and a control phase were included.	Further studies should include larger groups, research into comorbidity in vulnerable populations, intensity of therapy, and therapy type.

Participants

A total of 133 participants are included within the eight studies. Fourteen participants are reported to have never previously received gender-affirming voice therapy,[30, 35] and thirteen participants have previously received gender-affirming voice therapy.[35, 36] Whilst the potential for participant cross-over between studies cannot be entirely disqualified, the variety of geographical locations and detailed ages makes this unlikely. All participants included within these studies are recorded as being either trans women, trans feminine, transsexual or transgender individuals, or non-binary persons. The majority of these persons are either described,[30, 34, 37, 39] implied,[33, 35, 36] or presumed[38] by the researchers to have been errantly assigned male at birth (amab), and all were being supported in the 'feminization' of their voices. For the two studies that included non-binary persons, one indicated that the decision had been made to include all transfeminine individuals in need of support to make the voice and communication style less masculine,[38] and the other acknowledged that the feminization of voice was not a clear indication of the practice of gender affirming voice therapy, however all participants had their own specific targets which in some way involved a process of making the voice 'less masculine'.[36] In seven of the studies, age ranges are produced, revealing an age range of 15-70 years. Merrick et al., who have the largest cohort of participants, do not detail age ranges but provide a mean age of 38.1 years for their hybrid training group of nineteen persons, and 35.5 years for their individual training group of forty-three persons.[36] Individual location regions are not recorded, but the location details are provided in *Table 1* and are mentioned where applicable in subsequent discussions.

Intervention

Interventions were delivered in a range of locations from four separate countries, including La Trobe University Communication Clinic, Melbourne, Australia;[30, 38] an unspecified youth justice facility, with services being delivered by a SLP from the University of Melbourne, Australia;[39] The Voice Centre, St Michael's Hospital, Toronto, Canada between 2012 and 2019;[36] an unspecified clinic that is implied to be connected to the National Medical Centre, Budapest, Hungary at which the first six authors of the paper are based;[37] George Washington University Speech and Hearing Centre, Washington D.C., USA;[34] an unspecified outpatient university clinic and through home practice, USA;[35] and through the Voice and Communication Program for People in the Transgender Community, Ithaca College, New York, USA, between 2019 and 2021.[33]

A summary of intervention procedures for each study is provided in *Table 1*. Additionally, as can be viewed in *Table 2,* the studies that made reference to specific therapies, therapeutic programs and techniques detailed the following interventions as having been employed:

Table 2. Comparison of Interventions Used in Each Study

Intervention	**Study**							
	Carew et al., 2007.[30]	Chadwick et al., 2022.[33]	Hancock & Helenius, 2012.[34]	Hawley & Hancock, 2021.[35]	Merrick et al., 2022.[36]	Mészáros et al., 2005.[37]	Quinn et al., 2022b.[38]	Quinn & Swain, 2018.[39]
Oral resonance therapy modified from Boone (1977)[31]	X	-	-	X	-	-	-	-

and Martin and Darnley (1992)[32]								
Stemple's vocal function exercises (1993)[40]	-	-	-	-	-	-	X	X
Verdolini-Abbott's Lessac-Madsen Resonant Voice Therapy (2008)[41]	-	-	-	-	-	-	X	X
Diaphragmatic breathing from Nasser Kotby's version of the Accent Method (1995)[42]	-	-	-	-	-	-	X	-
Titze's semi-occluded vocal tract exercises (2006)[43]	-	-	-	-	X	-	X	-
Intensive programs	-	-	-	-	-	-	X	X
Traditional programs	X	X	X	X	-	X	X	-
Individual therapy	-	X	X	X	X	-	X	X
Hybrid therapy	-	-	-	-	X	-	-	-

Key: (X) = Intervention used; (-) = Not an intervention used.

All of the studies include a combination of participant self-evaluation and recorded acoustic measures, with three quarters of the studies also including either clinician or listener perceptual appraisal. The relevant measures or measurement tools for each of the studies are listed in *Table 3*.

Table 3. Summary of Intervention Measurement/Tools

Study	Participant	Acoustic	Clinician	Listener
Carew et al., 2007.[30]	VAS	*f0*, f_1, f_2 & f_3.		VAS
Chadwick et al., 2022.[33]	TWVQ	*f0* mean & range		
Hancock & Helenius, 2012.[34]	TSEQ	*f0*, f_1 & f_2, & speech rate.	CAPE-V	VAS
Hawley & Hancock, 2021.[35]	VAS	*f0*	CAPE-V	VAS
Merrick et al., 2022.[36]	TWVQ	*f0* & range		
Mészáros et al., 2005.[37]	Impairment rating (FDI)	*f0*, range, and phonation time & intensity.	Voice quality (FDI)	
Quinn et al., 2022b.[38]	TWVQ & VAS	*f0* mean & range, & AVQI		VAS
Quinn & Swain, 2018.[39]	TVQ^{MtF}, interview & VAS	*f0* mean & range, plus semitone range. Multi-Speech perturbation measure.	Subjective indication	VAS

Abbreviations: VAS, Visual Analog Scale; TWVQ, Trans Woman Voice Questionnaire; TSEQ, Transgender Self-Evaluation Questionnaire; CAPE-V, Consensus Auditory-Perceptual Evaluation of Voice; FDI, Friedrich dysphonia index; AVQI, Acoustic Voice Quality Index; TVQ^{MtF}, 'Trans-sexual' Voice Questionnaire – male to female. (TVQ^{MtF} uses terminologies that are now less commonly used, and has been revised to form the TWVQ.)

Outcomes

Within the studies, patient self-perception measures are primarily recorded through either VAS or variations of TWVQ (formerly known as TVQ^{MtF}, a revised form of TSEQ)[33]. Mean scores derived from these studies are detailed in *Table 4*. Reported measures across all eight studies suggest that participants in gender-affirming interventions demonstrate some degree of improvements after intervention, including specific perceptions of increased femininity,[30, 35, 38, 39] improved vocal functioning and voice-related quality of life,[33, 34, 36, 38, 39] and a reduction in perceived communicative impairment.[37] The only study that provides a control group indicates that communicative impairment remains high without intervention.[37]

Table 4. Mean scores of Self-report Tools

Study	Self-Report Tool	Scores (pre/post-intervention means)
Carew et al., 2007.[30]	VAS femininity	3.4-5.6
	VAS satisfaction	3.4-5.4
Chadwick et al., 2022.[33]	TWVQ *	74.9-54.8 (89% showed positive improvements)
Hancock & Helenius, 2012.[34]	TSEQ *	106/120-53/120
Hawley & Hancock, 2021.[35]	VAS	9.75-69.5
Merrick et al., 2022.[36]	TWVQ *	Hybrid group: 90.7-50.1. Individual group: 86-48.4.
Mészáros et al., 2005.[37]	FDI communication impairment *	Treatment group: 3-0. Control group: 3-3.
Quinn et al., 2022b.[38]	TWVQ functional *	Traditional group: 45.9-28.77. Intensive group: 38.53-26.94.
	TWVQ participation *	Traditional group: 30.71-18.54. Intensive group: 23.59-17.53.
	VAS (feminine) *	Traditional group: 84.57-21.05. Intensive group: 66.41-21.35.
Quinn & Swain, 2018.[39]	TVQ^{MtF} *	100/120-81/120
	VAS post therapy	9/10 intervention helpfulness; 7/10 change noticed

Abbreviations: VAS, Visual Analog Scale; TWVQ, Trans Woman Voice Questionnaire; TSEQ, Transgender Self-Evaluation Questionnaire; FDI, Friedrich dysphonia index; TVQ^{MtF}, 'Trans-sexual' Voice Questionnaire – male to female.

* Decreasing scores demonstrates positive improvement or progression towards goals. All reported changes were statistically significant.

Acoustic measures of treated voices primarily address modification of speech fundamental frequencies (*f0*), with all studies giving an indication of participants' *f0*s before and after intervention. These are described in *Table 5* alongside the other acoustic measures drawn from the studies. The largest increase in mean *f0* is 43.8Hz, recorded from the forty-three participants included in the individual therapy model studied by Merrick et al. (2022).[36] The smallest increases appear in the spontaneous speech of Quinn and Swain's (2018) single-case study (1.26 Hz) which indicates greater pitch increases during reading (26.79Hz),[39] and

in Carew et al.'s (2007) study of oral resonance therapy (13.9Hz).[30] Without therapeutic intervention, the single control within the data attained an increase of 29Hz.[37] Other acoustic measures reveal improvements in voice quality,[38, 39] improvements in rate,[34] and improvements in intensity.[34, 37] Phonation time is noted to improve through therapy in some instances,[37] but to considerably diminish with both other subjects not receiving therapy[37] and receiving therapy.[34] Through oral resonance therapy, vowel formant layers were raised to sit within more feminine ranges, particularly for front vowels, with the raised back vowels /u:/ and /ʊ/ being less receptive to modification.[30, 34]

Table 5. Comparison of Participants' Acoustic Measures pre and post-intervention

Study	*f0* (Hz)	Range	Other
Carew et al., 2007.[30]	119.4-133.3		Formants: f_1, f_2 & f_3 mean raised in /i/, /a/ & /ʊ/. f_1 & f_3 range increased in /i/, /a/ & /ʊ/ and f_2 range increased in /i/ & /a/.
Chadwick et al., 2022.[33]	138.1-163.8 (read.) 136.3-162.8 (spon.)	299.1-299.2Hz (read.) 291-315.7Hz (spon.)	
Hancock & Helenius, 2012.[34]	[205-209 (/a:/)] 150-188.67 (speech)	21-27 semitones	Phon. time: 20-13s Rate: 282-c.200wpm. Intensity: 61-64dB
Hawley & Hancock, 2021.[35]	128.75-170.75		
Merrick et al., 2022.[36]	135.9-161.5 (hybrid) 131.5-175.3 (individual)	19.2-20.2 semitones (hybrid) 19.2-20.4 semitones (individual)	
(treatment) Mészáros et al., 2005.[37] *(control)*	150.67-191.33	18.33-17.66 semitones	Intensity: 36.33-57dB. Phon. time: 22-24s
	127-156	20.5-24.5 semitones	Intensity: 32.5-37.5dB. Phon. time: 16.5-11s
(traditional) Quinn et al., 2022b.[38]	131.85-171.77 (read.) 130.99-164.13 (spon.)	263.74-350Hz	AVQI: 4.67-4.37
(intensive)	147.7-173.87 (read.) 141.84-160.17 (spon.)	555.52-528.97Hz	AVQI: 4.16-3.84
Quinn & Swain, 2018.[39]	145.92-172.71 (read.) 142.99-144.25 (spon.)	72.62-80.48Hz (read.) 75.01-77.53Hz (spon.)	Perturbation: voice pathology pre-therapy, none post-therapy.

Abbreviations: read., reading; spon., spontaneous speech; Phon. time, phonation time; AVQI, Acoustic Voice Quality Index.

Of the five studies that provide listener and clinician perceptions, there are indications that participants' voices were generally more feminine after treatment than before,[30, 34, 35, 38,

[39] that this correlated with movements from hard to soft sounds,[34] and persisted after therapy had ended.[34] In one instance, the voice was described as more feminine in reading than in discourse,[39] and in a study of thirty-four participants an increase in vocal femininity did not necessarily progress the voices beyond a gender neutral range.[38]

Quality Appraisal

Table 6. Study Validity Scores

		Study							
		Carew et al., 2007.[30]	Chadwick et al., 2022.[33]	Hancock & Helenius, 2012.[34]	Hawley & Hancock, 2021.[35]	Merrick et al., 2022.[36]	Mészáros et al., 2005.[37]	Quinn et al., 2022b.[38]	Quinn & Swain, 2018.[39]
Population	*1.1 well described*	+	++	++	++	++	+	++	++
	1.2 rep. of source pop.	+	+	-	-	+	-	+	+/-
	1.3 rep. of eligible pop.	-	-	-	-	+	-	+	+/-
Selection	*2.2 interv. described*	+	++	++	+	++	+/-	++	++
	2.4 partic./res. blinded	+	/	+	/	/	/	-	+
	2.9 reflects practice	++	++	++	+	++	++	++	+
Outcomes	*3.1 reliably measured*	++	++	++	++	++	++	++	++
	3.4 relevant	++	++	++	+	++	++	++	++
	3.6 follow-up time	-	-	+	-	-	-	+	+
Analysis	*4.3 suffic. powered*	-	-	-	-	+	-	++	-
	4.4 effect size given	+	+	-	+	++	-	++	++
	4.5 approp. analysis	++	++	+	++	++	+	++	++
	4.6 interv. effects given	++	++	-	++	++	-	++	++
Summ.	*5.1 internally valid*	+	+	+	+	+	+/-	++	++
	5.2 generalizable (E.V.)	+	+	-	+	++	-	++	+
Validity (n/30)		17	18	14	14	22	9	25	21

Scored: Met (++) = 2; partially met (+) = 1; not met (-), not recorded/applicable (/) = 0. Abbreviations: rep., representative; pop., population; interv., intervention; partic., participant; res., researcher; suffic., sufficiently; approp., appropriate; summ., summary; E.V., external validity.

The quality of the eight studies have been assessed on both internal validity (sections 2, 3, 4 and 5.1) and external validity (sections 1 and 5.2),[28] and provided with an overall validity rating for comparison, as can be viewed in *Table 6*. Due to the small population sizes

across the range of studies, with 75% featuring 1-16 participants (m=6), the studies are only sufficiently powered in one study, and are only generalizable to the wider population in 25% of the studies. Blinding within the studies is rare, and only implemented for small listener groups, and none of the studies have extended follow-up times to effectively measure the ongoing effectiveness of intervention, which diminishes the internal validity of the studies. However, interventions are generally well described, accurately reflect general practice, and are reliably measured using suitable tools.

Discussion

This systematic review was compiled with the primary objective of querying the efficacy of voice and communication therapy in aiding transgender and gender non-conforming individuals towards the attainment of a greater sense of gender congruence. A secondary aim was to explore whether the available evidence indicates that specific modes or models of intervention are more likely to prove effective in supporting patients towards their individual goals. Whilst the studies included in this paper only include a small number of participants and thus demonstrate limited external validity and generalizability, they do present a number of preliminary revelations in relation to the title questions.

The study results indicate that through therapeutic intervention acoustic measures can be modified in line with gender specific goals, including speech fundamental frequencies being raised to a gender neutral or perceptually feminine range (all studies), and formant frequencies being raised to pitches that resemble or match those perceived as a more feminine resonance profile with varying degrees of success relating to the position of the different vowels within the oral cavity.[30, 34] It is further implied that patients attempting to engage in voice change without clinical support perpetuates communicative impairments and may increase the likelihood of vocal pathologies emerging.[37] The majority of participants within these studies report a greater degree of satisfaction with their voices after receiving gender-affirming voice therapy, declaring an increase in self-confidence and in social participation related to voice change alongside an increase in voice function.[38] This is reflective of previous findings of improved voice quality in trans women, as relayed through the perspective of the ICF model.[44] It is acknowledged, however, that participant biases may have influenced the self-report results taken as post-therapy outcome measures for each study,[30] and thus, as described by Greenhalgh (2014), extrapolating from these results for the wider population must also take into account the effects of confounds upon the validity of these results.[45]

The studies indicate that pitch elevation alone does not necessarily alter a listener's perception of a speaker's gender,[30] and thus a therapy plan that tackles multiple facets of communication is appropriate.[33, 34, 38] Interventions that are suggested to be beneficial include oral resonance therapy,[30, 34, 38] although some contraindications to the efficacy of this are related by Quinn and Swain (2018),[39] and vocal function exercises,[38, 39] but most of the studies include a combination of therapeutic interventions for a complete communication approach. Both intensive and traditional therapy models reveal similar results,[38] however, whilst hybrid and individual therapy models reveal similar acoustic results, a hybrid model can increase patient adherence and seems to also increase the chances of a patient attaining their specified goals.[36] It is also indicated that combining clinical interventions with the provision of supportive home therapy aids, such as telephone applications, can be beneficial for increasing patient compliance and maintaining communication improvements between clinic sessions. However, it is noted that all patients engaging in home therapy also required support from clinicians to modify voice quality and manage 'naturalness' of speech.[35] It is

suggested that beginning communication therapy for younger persons might increase the efficacy of treatment,[34, 39] but further studies will be required to address this implication.

Limitations

Owing to the relatively small number of papers included within this systematic review, and the low numbers of participants in the majority of these studies, the conclusions of this review cannot confidently be extrapolated for use in clinical practice with wider populations. To counter this limitation, several of the studies recommend that further investigations are required, investigating larger cohorts and broader study designs,[30, 34, 36, 38, 39] more diverse populations,[35, 38] and more representative populations such as including a representative range of ages, ethnicities and socio-economic confounds.[35, 39] Whilst these studies are assessed to present varying degrees of validity, the levels of evidence are positioned at the lower end of the evidence hierarchy, and thus it would be beneficial for future studies to be completed with higher levels of evidence, such as randomized control trials.[45] As described by Davies et al. (2015), such studies should include considerations of therapeutic efficacy for this population, but should also compare different therapeutic interventions and explore the benefits of these in greater detail.[46]

It has been acknowledged that therapy with this population should be person-centred[9] and that increased quality of life and the diminution of gender incongruence should form a primary component within gender-affirming care.[13] However, the limited number of papers included in this review are indicative of the paucity of studies that include patient self-report data as a primary outcome measure. Previous reviews and papers have acknowledged a need to consider subjective perceptions of gender from voice but are still grounded within a conceptual need for patients to 'pass' as cisgender.[8, 47] Future studies should therefore always include subjective participant evaluations based upon individual communication targets, alongside corresponding objective measures.[34, 38] It would also be beneficial to engage in more expansive studies into the efficacy of therapy for the broader population, including trans men, trans masculine and non-binary individuals[38] as these groups are currently severely under-represented outside of studies into voice change through hormone therapy.[48, 49, 21]

Implications

The World Professional Association for Transgender Health (WPATH) recommends support in voice and communication modification for the reduction of gender incongruence as part of its core standards of care.[27] Despite these recommendations, there is currently limited evidence for the efficacy of therapeutic interventions beyond anecdotal evidence reported by clinicians and patients,[46, 13] and studies focused upon effectiveness as measured purely through acoustic transformation.[50] However, an increase in research has recently been witnessed,[13] and studies that include patient self-perception measures as therapeutic outcomes are now emerging.[47, 24]

As visibility and acceptance of transgender persons grows in many places around the world, a political and social 'push back' has been seen in a number of countries, fueled by misunderstanding and political and media-led misrepresentation and misinformation.[51] This has been exemplified in the USA, where 106 new bills of restrictive legislation for transgender persons have been introduced since 2022 (as reported by Gallant (2023) and the Trans Legislation Tracker [TLT] (2023));[52, 53] the United Kingdom, which was visited in 2023 by the United Nations' Independent Expert on protection against violence and discrimination based on sexual orientation and gender identity in response to 'toxic political discourse' and 'alarming' attempts to modify the Equalities Act 2010 and replace the Human Rights Act 1998, which would detrimentally affect transgender persons;[54] Australia, where anti-transgender rallies were held in 2023;[55] and a global increase in the reported murders of

transgender individuals.[56] This has also been reflected through legal and legislative restrictions to medical care in certain countries, including Britain and North America.[57, 53] Accordingly, it is now even more important that evidence can be provided for both the need for clinical interventions and for their effectiveness in the reduction of gender incongruence.

Conclusion

This systematic review demonstrates that voice and communication therapy can be effective for supporting the raising of fundamental frequency (all studies)[30, 33-39] and vocal resonance towards a perceptually feminine range (Carew et al., 2007; Hancock & Helenius, 2012),[30, 34] whilst avoiding increasing the risk of vocal pathology (Mészáros et al., 2005).[37] All eight studies also indicate that communication therapy can improve quality of life, self-confidence and social participation, as well as the perceived attainment of a closer approximation to a congruent voice.[30, 33-39] To better evidence the efficacy of gender-affirming voice therapy, larger scale studies, such as well-designed randomized control trials, are still required.[45] Future studies should also address the efficacy of 'masculinization' or androgenizing effects within voice and communication therapy, and should compare participants that are in receipt of therapy with appropriate control groups.[24]

Declaration of Competing Interest

The authors have no competing interests to disclose.

Additional Limitations

This systematic review was not registered with PROSPERO prior to data extraction.

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