

Review

Transmasculine people's vocal situations: a critical review of gender-related discourses and empirical data

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Abstract

Background: Transmasculine people assigned female sex at birth but who do not identify with this classification have traditionally received little consideration in the voice literature. Some voice researchers and clinicians suggest that transmasculine people do not need attention because testosterone treatment leads to a satisfactory masculinization of their voice organs and voices. Others, however, argue that transmasculine people are a heterogeneous group whose members might not share the same body type, gender identity or desire for medical approaches to gender transitioning. Therefore, testosterone-induced voice changes may not necessarily meet the needs and expectations of all transmasculine people.

Aims: To evaluate the gender-related discursive and empirical data about transmasculine people's vocal situations to identify gaps in the current state of knowledge and to make suggestions for future voice research and clinical practice.

Methods & Procedures: A comprehensive review of peer-reviewed academic and clinical literature was conducted. Publications were identified by searching seven electronic databases and bibliographies of relevant articles. Thirty-one publications met inclusion criteria. Discourses and empirical data were analysed thematically. Potential problem areas that transmasculine people may experience were identified and the quality of evidence appraised.

Main Contribution: The extent and quality of voice research conducted with transmasculine people so far was found to be limited. There was mixed evidence to suggest that transmasculine people's vocal situations could be regarded as problematic. The diversity that characterizes the transmasculine population received little attention and the complexity of the factors that contribute to a successful or unsuccessful vocal communication of gender in this group appeared to be under-researched. While most transmasculine people treated with testosterone can expect a lowering of their pitch, it remains unclear whether the extent of the pitch change is enough to result in a voice that is recognized by others as male.

Conclusions & Implications: More research into the different factors affecting transmasculine people's vocal situations that takes account of the diversity within the population is needed.

Keywords: female-to-male transgender, female-to-male transsexual, gender diversity, voice, voice problem, voice treatment.

What this paper adds?

What is already known on the subject?

Transmasculine people who identify as male and are interested in being treated with testosterone can benefit from the pitch-lowering effects of this hormone because pitch is widely regarded as the key factor influencing perception of vocal gender. However, due to the heterogeneity of the transmasculine population and the complexity of the processes involved in the production of gender within interactions, it is contested among voice specialists whether transmasculine people's vocal situations can be considered generally unproblematic and whether attention from voice researchers and clinicians is warranted.

What this paper adds?

While findings from this review confirm that most transmasculine people who are treated with testosterone can expect lowering of voice pitch, other factors affecting transmasculine people's vocal situations have been under-explored. Specific recommendations to improve the quality of future research to inform an evidence-based approach to specialized voice support for this diverse population are provided.

Introduction*From 'transsexual' to 'transgender'*

Since the mid-1970s voice researchers and clinicians have demonstrated a growing interest in people who are inconsistently referred to as either 'transsexual' (e.g. Oates and Dacakis 1997: 178), 'transgender' (e.g. McNeill *et al.* 2008: 727), or 'transgender/transsexual' (Adler *et al.* 2012b). Traditionally, voice specialists have looked to mental health professionals and classifications of psychiatric conditions to have the membership criteria for this client group defined. For example, the International Classification of Diseases (ICD-10) defines 'transsexualism' (F64.0) as a form of 'mental and behavioural disorder' (F00–F99):

[The] desire to live and be accepted as a member of the opposite sex, usually accompanied by a sense of discomfort with, or inappropriateness of, one's anatomic sex, and a wish to have surgery and hormonal treatment to make one's body as congruent as possible with one's preferred sex. (World Health Organisation 2010)

The ICD-10 definition of transsexualism is informed by a theoretical perspective on sex and gender identity that has been widely challenged by transgender activists and gender studies scholars for its biological determinist and binary orientation and its homogenization and pathologization of gender diversity (e.g. Cromwell 1999, Feinberg 1996, Kessler and McKenna 1978). However, until recently, these criticisms have been ignored by voice researchers and clinicians. It took until the late 1990s (e.g. Gelfer 1999) before the term 'transgender' first appeared in the voice literature and now it is still mostly used interchangeably with 'transsexual'. To date, only a few accounts are published where authors acknowledge that 'transgender' is a term that can be understood in various ways, some of which are no longer compatible with the medico-scientific perspective on sex and gender identity mentioned above (e.g. Davies and Goldberg 2006, Azul 2013b). A transgender person might reject the concept of a biological determination of gender and consider themselves as someone 'who moves across genders [. . . without] being essentially or permanently committed to one or the other gender' (Kessler and McKenna 2000: n.p.). Alternatively, a person might also transgress the understanding of sex and gender as binary categories and consider themselves as someone 'who has gotten

through gender, beyond gender. No clear gender attribution can be made, or is allowed to be made' (Kessler and McKenna 2000: n.p.). For the remainder of this paper 'transgender' will be used as an overarching term to refer to all people who do not recognize themselves in the sex or gender category attributed to them at birth. This understanding includes the notion of transsexualism as defined in the ICD-10 and all subjective positionings regarding gender observed in human beings.

The clearest indication to date that the medico-scientific discourse on gender diversity might be at the point of a terminological and conceptual transformation was provided in the recent edition of the 'Standards of care for the health of transsexual, transgender, and gender-nonconforming people' (Coleman *et al.* 2012) where the authors argue that 'the expression of gender characteristics, including identities, that are not stereotypically associated with one's assigned sex at birth is a common and culturally diverse human phenomenon [that] should not be judged as inherently pathological or negative' (168). In addition to recommending a 'de-psychopathologization of gender nonconformity' (168) the standards of care acknowledge that transgender people's subjective gender positionings can no longer be limited to either 'male' or 'female' and that requests for medical approaches to gender transitioning may be highly variable: some transgender people may:

not feel the need to feminize or masculinize their body. For others, changes in gender role and expression are sufficient to alleviate gender dysphoria. Some patients may need hormones, a possible change in gender role, but not surgery; others may need a change in gender role along with surgery but not hormones. (170–171)

Following these fundamental changes to the recommendations for clinical practice with transgender people, this paper is informed by the perspective that transgender people comprise a heterogeneous group whose members present with variously shaped bodies, diverse gender positionings, and possibly limited desire to engage in current medical approaches to gender transitioning.

'Transmasculine' people

The particular subgroup of the transgender population of interest to this study has been variably referred to as 'female-to-male transsexuals' (e.g. Van Borsel *et al.* 2000: 427), 'female-to-male transgenders' (e.g. Scheidt *et al.* 2004: n.p.), or the 'transmasculine community' (Hansbury 2005: 242). Additionally, members of this group may describe themselves by using other terms that indicate unease with being exclusively categorized as 'female' (e.g. Hansbury 2005, Cromwell 1999).

In an attempt to make visible different gender positionings, Hansbury (2005) distinguished three subgroups of the 'transmasculine community': 'woodworkers', 'transmen' and 'genderqueers' (242). 'Woodworkers' are female-to-male transsexuals in the same sense as that ascribed in the ICD-10, that is, people assigned female sex at birth but who present with a desire to live and be accepted as a male, and who wish to have surgery and hormonal treatment to make their body as congruent as possible with notions of the male norm. These people 'identify themselves as men, minus any transspecific prefixes, and are sometimes called Woodworkers by other transpeople because of their tendency to blend into the woodwork' (Hansbury 2005: 246). By contrast, 'transmen' are those who acknowledge that they live in bodies that persist [...] in being neither female nor wholly male' (252). 'Trans' is used as a prefix here that is 'perpetually in the act of changing, forever crossing from one side to the other[...]. It has nothing to do with arrival, or departure. It is forever about the journey' (252). And finally, 'genderqueers' are people who 'defy classification' (256). They may seek a 'place in the middle, outside any and all boxes. Many eschew gender-specific pronouns, or, conversely, they embrace ambiguity' (258). 'Transmen' and 'genderqueers' might decide against surgery or hormones or may request certain surgeries or lower doses of hormones or may be yet to decide how far they will make use of medical approaches to gender transitioning.

For the remainder of this paper 'transmasculine' will be used as an overarching term to refer to all people assigned female sex at birth but who do not feel properly described by this classification.

'Vocal situations' of transmasculine people

Voice specialists have claimed that transmasculine people encounter fewer voice and communication problems than transfeminine people because administration of testosterone increases vocal fold mass and induces lowering of voice pitch (e.g. McNeill *et al.* 2008, Rosanowski and Eysholdt 1999) whereas 'the converse use of estrogens generally does not have a marked effect upon pitch level' (Bralley *et al.* 1978: 444). As pitch is widely

considered the key factor influencing the perception of vocal gender (Oates and Dacakis 1997), testosterone treatment is seen to increase the likelihood that transmasculine people will be perceived and addressed in their encounters as members of the male gender. Based on these considerations, some commentators contend that 'sex change from female to male does not generally entail vocal problems' (Descloux *et al.* 2012: 41) or that 'voice therapy for the female-to-male transsexual is unnecessary' (Pettit 2004: 224). These perspectives are supported by assertions that voice changes experienced by transmasculine people as a result of hormone treatment amount to 'masculinization' (Oates and Dacakis 1997: 178), or that the hormonally changed voice corresponds to a transmasculine person's 'desired voice' (McNeill *et al.* 2008: 727), and that 'female-to-male transsexuals will usually pass as members of the masculine gender' (Söderpalm *et al.* 2004: 18).

However, some general comments made about transmasculine people in the voice literature include important qualifications that call into question assumptions of an unproblematic hormonal sexing of the voice as organ and as acoustical and auditory event. Such qualifications can be summarized as follows. The effect of testosterone on the voice of transmasculine people is not always the same. Aspects that may differ between individuals include: the extent of fundamental frequency decrease (e.g. Mueller *et al.* 2010); the degree of satisfaction with the changed voice (e.g. de Bruin *et al.* 2000); whether or not the changed voice is perceived as 'male' or 'masculine' by transmasculine people themselves or by others (e.g. Rosanowski and Eysholdt 1999); and the degree to which the voice change occurs automatically or requires additional intervention from voice professionals (e.g. McNeill *et al.* 2008). Additionally, some authors mention aspects of voice and communication other than voice pitch associated with gender, such as, articulation, resonance, vocabulary choices, and nonverbal behaviour. These are not expected to alter with androgen administration and may require intervention from voice professionals (e.g. Oates and Dacakis 1997). Over and above any concern with the impact on gender-related aspects of voice, testosterone may have negative effects on vocal functioning (such as, restrictions of phonational frequency range, voice quality, and vocal power) (e.g. Antoni 2007). A review of the voice literature in terms of the vocal functioning-related aspects of transmasculine people's vocal situations will be the focus of another study.

Apart from questions about the current state of knowledge regarding the pros and cons of testosterone treatment, there are other reasons why a closer scrutiny of the voice literature on transmasculine people is indicated. An attempt to account for the heterogeneity that characterizes this group is needed. Both research

and clinical practice should be evaluated to establish how they accommodate the diversity of transmasculine people.

Voice researchers and clinicians may also need to consider theories of the production of gender within interactions to gain better understanding of the complexity of the voice issues transmasculine people may face. According to current theories (e.g. Azul 2013a, 2013b), whether a speaker is perceived or addressed by others as a member of the gender grouping to which they feel they belong is not solely dependent on the sexual characteristics of a speaker's body and voice organ. Rather, gender is seen as the—variable and individually not controllable—outcome of a collaborative 'doing' involving both speaker and listener(s) and the norms of sex and gender prevalent in different social and cultural settings. In order to reflect this understanding, the term 'vocal situation' is used.

In this study, transmasculine people's vocal situations were conceptualized as shaped by 'presentational factors' (the transmasculine speaker's contributions), 'attributional factors' (the listeners' contributions), and 'normative factors' (standards of 'masculinity' or 'femininity' to which the speaker's contributions are compared) (figure 1). Specifically, the presentational factors consist of: the method(s) used to change vocal gender presentation; the anatomical dimensions of the voice organ; and gender-related voice features. The attributional factors consist of the transmasculine speaker's self-perception of voice with regards to gender and of gender attribution(s) to the speaker's voice by others.

Given the diversity and complexity of factors shaping the gender-related aspects of transmasculine people's vocal situations and the variety of perspectives on this topic, it was decided that a critical review of the voice literature was needed to identify gaps in the current state of knowledge and to formulate suggestions for future voice research and clinical practice with transmasculine people.

Based on the model of the gender-related aspects of transmasculine people's vocal situations described above, the aim of this review is to appraise the voice literature to investigate how well it addresses:

- The diversity of transmasculine people in terms of their subjective gender positionings and the methods they use to change their vocal gender presentation.
- The presentational, attributional, and normative factors shaping transmasculine people's vocal situations.
- Gender-related voice problems in transmasculine people.

Method

Search methods, inclusion and exclusion criteria

A comprehensive search of six electronic databases (Medline, CINAHL, Embase, Scopus, DIMDI-Recherche and MEDPILOT) was conducted in May 2013 and again in October 2013. An additional search of PsycINFO was conducted in January 2014 but did not yield any additional papers (see table 1 for the search term combinations used).

Publications were considered for inclusion if: they were peer-reviewed articles and book chapters; the abstract was available in English or German; and they were concerned with the notion of voice in the material sense (i.e. voice as sound) rather than metaphorical sense (i.e. voice as political representation). Publications were excluded if they were solely focussed on transfeminine people. Bibliographies of review and empirical articles were also searched for additional studies.

Review foci

The publications included in the review were classified according to study design criteria within the Joanna Briggs Institute hierarchy of evidence (Joanna Briggs Institute 2013) and the quality of evidence from primary research studies was appraised.

Analyses of discourses and empirical data focused on three areas: the attention given to transmasculine people's diversity; the comprehensiveness of the examination of transmasculine people's vocal situations; and how gender-related voice problems transmasculine people experienced were evaluated. The approach to each analysis is described in more detail below.

Quality of evidence from primary research studies

The following aspects were considered: study design and sample size; detail provided on methods used to change vocal gender presentation; and specification of examination methods, speech tasks and normative values.

Attention to diversity of study population

First, publications were examined to determine whether data recorded research participants' descriptions of subjective gender positionings. Next, the terminology and definitions of terminology authors used to describe transmasculine people's gender positionings were analysed and categorized. Finally, publications were analysed for the method(s) used to change vocal gender presentation that they described or evaluated.

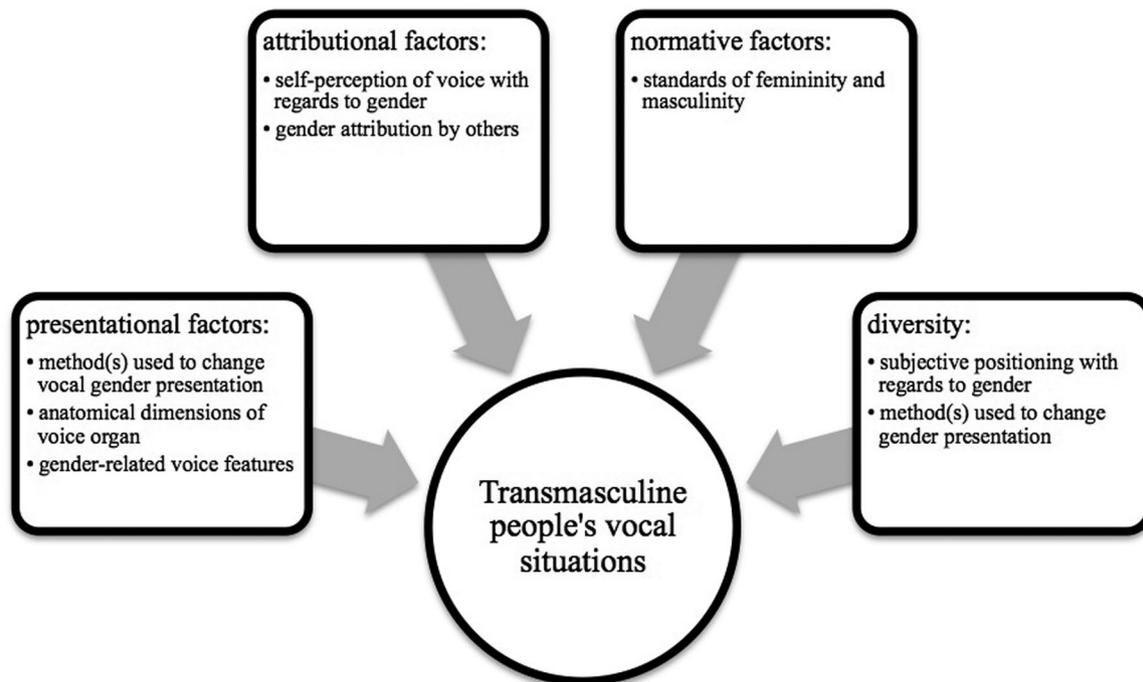


Figure 1. Gender-related aspects of transmasculine people's vocal situations.

Table 1. Search terms

Concepts	Population	Vocal situation
English	transsex* transgend* gender dysphor* gender identity disord*	voice voice disord* dysphon* voice train* voice therap* voice treat* stimm*
German	transsex* transgend*	

Comprehensiveness of the examination of transmasculine people's vocal situations

Publications were analysed for how comprehensively they examined the different presentational, attributional, and normative factors affecting transmasculine people's vocal situations.

Evaluation of gender-related voice problems

Publications were analysed for any comments and data relating to the presence of gender-related voice problems in transmasculine people. Outcomes from primary research studies were examined across treatment methods (testosterone treatment, laryngeal surgery or voice treatment). Reported fundamental frequency data were

compared with the upper border of the normative range for biological males of 131 Hz (Böhme 1997) and results below this value were judged as sufficiently lowered. Results above 131 Hz were judged to be insufficiently lowered.

Results

Results of an extensive search of the literature revealed that articles focused on transfeminine people outnumbered articles focused on transmasculine people by a ratio of approximately 3:1. The initial searches identified 236 possible papers. Following application of the inclusion criteria to titles and abstracts, a total of 111 publications were retrieved and considered for inclusion. Of these, 84 (76%) were excluded because their sole focus was transfeminine people. Twenty-seven publications remained with four additional publications identified through bibliography searches to give 31 publications included in the review (figure 2).

Thirty-two different studies were identified in the 31 publications under review. Two publications reported data from the same study while two other publications reported findings from two separate studies. Fifteen studies (47%) were classified as 'expert opinion' (evidence level 4) and will be referred to as 'expert opinion papers' in the remainder of this article. Two of the

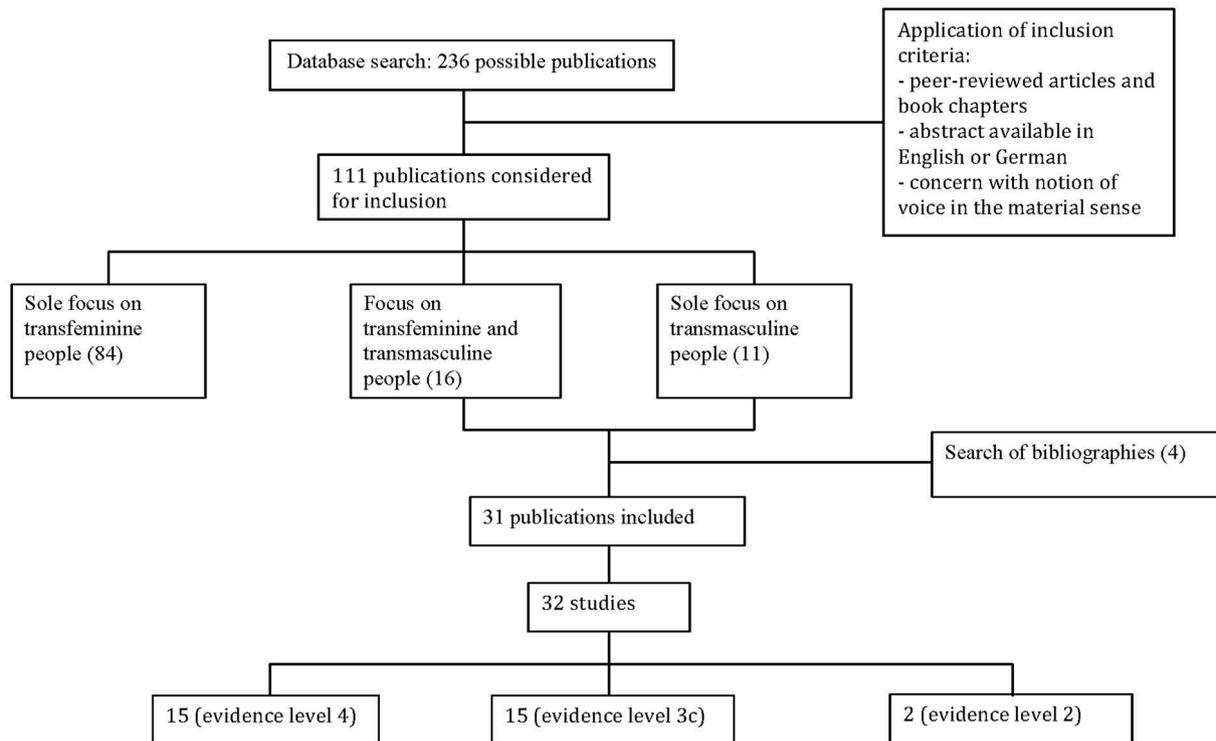


Figure 2. Literature search flow diagram.

Table 2. Study designs and levels of evidence

Design	Quasi-experimental study without randomization	Observational study without control group	Expert opinion
Level of evidence	2	3c	4
Joanna Briggs Institute (2013)	Nakamura <i>et al.</i> (2013) Yuko <i>et al.</i> (2012)	**Adler <i>et al.</i> (2012a) ^a Damrose (2009) Gooren and Giltay (2008) Kojima <i>et al.</i> (2008) Martin <i>et al.</i> (1984) Mueller <i>et al.</i> (2010) Pobisova <i>et al.</i> (1985) *Scheidt <i>et al.</i> (2003, 2004) Söderpalm <i>et al.</i> (2004) T'Sjoen <i>et al.</i> (2006) Vague <i>et al.</i> (1984) **Van Borsel <i>et al.</i> (2000) ^a **Van Borsel <i>et al.</i> (2000) ^b Van Borsel <i>et al.</i> (2009) Yamasaki <i>et al.</i> (2003)	**Adler <i>et al.</i> (2012a) ^b Antoni (2007) Azul (2013a) Coleman <i>et al.</i> (2012) Davies and Goldberg (2006) Gooren (2005) Moerman <i>et al.</i> (2000) Moore <i>et al.</i> (2003) Neuschaefer-Rube <i>et al.</i> (2008) Oates and Dacakis (1997) Parker (2008) Pérez Alvarez (2011) Schüchner (2000) Spiegel (2006) Thornton (2008)

Note: Publications marked with an asterisk (*) report on the same study design and were only counted once; publications marked with a double asterisk (**) report on two studies with different designs ^(a,b).

remaining 17 studies were classified as 'quasi-experimental studies without randomization' (evidence level 2) and the other 15 as 'observational studies without control group' (evidence level 3c). These 17 studies comprise the 'primary research studies' referred to in the remainder of this article (table 2).

Quality of evidence from primary research studies

The overall quality of evidence from the primary research studies under review was judged to be poor with the majority of findings ranked at the bottom of evidence hierarchies. Fifteen of the 17 primary research studies (88%) reported longitudinal case series, case

Table 3. Appraisal of quality of evidence from primary research studies

Reference	Presentational aspects				Attributional aspects			
	Study design (sample size)	Method used to change gender presentation	Examination method	Speech tasks	Normative values	Examiners/examination method	Speech task/setting	Norm values
Damrose (2009)	Longitudinal case report (<i>n</i> = 1)	HT: IM (C)	F0	Vowel	n.s.			
Gooren and Giltay (2008)	Longitudinal case series (<i>n</i> = 712)	HT: IM (C)	n.s.	n.s.	n.s.			
Martin, Klingholz and Eicher (1984)	Cross-sectional study (<i>n</i> = 3)	HT (?)	F0,	n.s.	< 125 Hz			
Mueller <i>et al.</i> (2010)	Longitudinal case series (<i>n</i> = 45)	HT: IM (C)	FF	F1 /a/, F2 /i/, F3 /u/	comparison controls			
Nakamura <i>et al.</i> (2013)	Quasi-experimental study without randomization (<i>n</i> = 138)	HT: IM (C)	n.s.	n.s.	n.s.			
Pobisova, Heresova and Sipova (1985)	Longitudinal case series (<i>n</i> = 6)	HT: O (C)	n.s.	n.s.	n.s.			
Scheidt <i>et al.</i> (2003, 2004)	Cross-sectional study (<i>n</i> = 14)	HT: IM (M, D)	F0,	reading	< 131 Hz	interview (SP)	phone	n.s.
T'Sjoen <i>et al.</i> (2006)	Cross-sectional study (<i>n</i> = 20)	HT: IM, O (C)	FF	F1-F3 /a/, /i/, /u/	n.s.	clinician: n.s. independent listeners: gender attribution independent listeners: ferm.-masc. rating VHI (SP)	n.s. reading	n.s. male-female
Vague, Meignen and Negrin (1984)	Longitudinal case report (<i>n</i> = 1)	HT: IM (C)				survey researchers: n.s.	n.s. phone n.s.	n.s. n.s.
Van Borsel <i>et al.</i> (2000)a	Cross-sectional study (<i>n</i> = 16)	HT (D)	survey (SP)	n.s.	n.s.	survey (SP)	phone, encounter	n.s.
Van Borsel <i>et al.</i> (2000)b	Longitudinal case series (<i>n</i> = 2)	HT: O (C)	F0,	vowel, reading	n.s.			
Van Borsel, de Pot and de Cuyper (2009)	Cross-sectional study (<i>n</i> = 7)	HT (D)	jitter, shimmer F0	vowel reading	n.s. n.s.	independent listeners: maleness rating	monologue	1 = not at all male 10 = very male

Continued

Table 3. Continued

Reference	Study design (sample size)	Presentational aspects				Attributional aspects		
		Method used to change gender presentation	Examination method	Speech tasks	Normative values	Examiners/ examination method	Speech task/ setting	Norm values
Yamasaki, Douchi and Nagata (2003)	Longitudinal case report ($n = 1$)	HT: IM (C)	n.s.	n.s.	n.s.			
Yuko <i>et al.</i> (2012)	Quasi-experimental study without randomization ($n = 193$)	HT: IM (C)	n.s.	n.s.	n.s.			
Söderpalm, Larsson and Almqvist (2004)	Longitudinal case series ($n = 3$)	VT	F0	n.s.	n.s.			
Adler, Constansis and van Borsel (2012) ^a	Longitudinal case report ($n = 1$)	LS: TP _{III}	F0	reading, counting, vowel	n.s.	n.s.	phone	n.s.
Kojima <i>et al.</i> (2008)	Longitudinal case report ($n = 1$)	LS TP _{III}	F0	n.s.	n.s.			

Notes: HT = hormone treatment, IM = intramuscular application, O = oral application, (C) = complete details of hormone treatment regimen reported, (M) = method of hormone administration reported, (D) = duration of hormone treatment reported, (?) = no details of hormone treatment regimen reported, VT = voice therapy, LS = laryngeal surgery, TP_{III} = thyroplasty type III, n.s. = not specified, (SP) = self-perception, F0 = average fundamental frequency, FF = formant frequencies, VHI = Voice Handicap Index, no entry = not examined.

reports, or cross-sectional studies. Eighty-two per cent of primary research studies had a sample size of no more than 20 participants (table 3).

In one of the 14 studies that examined the effects of testosterone treatment on transmasculine people's vocal situations (7%), no details were provided about the hormone treatment regimens (type of testosterone, method of administration, dosage, duration) to which the participants were subjected. In two studies (14%), the authors reported the duration of testosterone treatment only; in another (7%), the authors reported the method of administration and duration of hormone treatment but reported no other details. In ten studies (72%), the complete details of the treatment regimens were given. Of these, seven publications reported the results of testosterone treatment administered intramuscularly, two reported on hormone treatment given via the oral route, and one on a group of transmasculine people some of whom were treated either by testosterone injections or orally.

In one study that evaluated the effects of voice therapy (Söderpalm *et al.* 2004), a combination of vocal hygiene and pitch changing exercises based on the principles of the Accent Method were used as the intervention method. From the information provided in the article, it could not be determined whether the participants had been treated with testosterone in addition to voice therapy. Another two studies evaluated the effects of laryngeal surgery (Adler *et al.* 2012a, Kojima *et al.* 2008). Thyroplasty type III was used as the intervention, which has a long-established and well-defined approach to pitch-lowering surgery (e.g. Isshiki *et al.* 1983).

For nine of the 27 sub-investigations undertaken in the primary research studies (33%), examination methods were not specified. Information about the speech tasks performed in examinations was lacking for 13 sub-investigations (48%). When speech tasks were reported, they were often not reflective of participants' everyday communication practices (e.g. vowel extensions). Normative values used to interpret findings with regards to gender were only specified for five examinations with information lacking for 22 sub-investigations (81%). For the investigations undertaken in eight studies (30%), neither examination methods, speech tasks, nor normative values were specified. All four studies with a sample size larger than 20 (including the two quasi-experimental studies) were among these.

Attention to diversity of the study population

On the whole, the diversity of transmasculine people's subjective gender positionings and the methods they use to change their vocal gender presentation received little attention in the publications under review.

Transmasculine people's gender positionings

Self-descriptions. Transmasculine people's subjective gender positionings were examined in only one primary research study. Results of semi-standardized interviews with 14 transmasculine people revealed that while all participants had been formally diagnosed as 'female-to-male transsexual', each positioned themselves variously with regards to gender: Seven described their positioning as 'male', three as 'neither male nor female', two as 'rather male than female', and one as 'male and female'. The remaining participant felt themselves not to have a gender identity at the time of the interview (Scheidt *et al.* 2003, author's translation).

Terminology and definitions used in publications. In 25 of the 31 publications under review (81%), transmasculine people were represented as one homogenous population that shared the characteristics of transsexualism as defined in the ICD-10. Authors of these publications used word constructions containing the terms 'transsexual', 'gender identity disorder', 'gender dysphoria' or 'gender reassignment' in various combinations with 'female', 'male' or 'female-to-male' in their descriptions (e.g. 'female-to-male transsexual', 'transsexual men', 'female undergoing gender reassignment', 'female with gender identity disorder'). Of these 25 publications, in seven (28%), authors stated that research participants had a confirmed diagnosis of transsexualism, gender identity disorder or gender dysphoria; in the remaining 18 publications (72%), reasons for the choice of a particular terminology or for failing to give attention to transmasculine people who do not identify as transsexual were not provided.

In six of 31 publications (19%), authors attended to a diversity of subjective gender positionings within the transmasculine population using a variety of terms and definitions of terms in their descriptions. Davies and Goldberg (2006: 168) referred to transmasculine people as 'transgender individuals in [...] the female-to-male (FTM) continuum'. This terminology describes 'a spectrum of people [...] who were assigned 'female' at birth and who wish to masculinize or de-feminize their speech. This breadth of terminology is used to promote inclusion of non-transsexual clients who may seek speech [...] masculinization services' (188). These included crossdressers, bi-gendered, and androgynous people. Neuschaefer-Rube *et al.* (2008) pointed out that 'people who do not identify with the sex that was assigned to them at birth and with the associated expectations around gender presentation and gender role often do not define themselves in the same way as described in the ICD-10' (175, author's translation). As an example, these authors referred to the following definition of the

term ‘transman’ as it is used by a German advocacy group for transmasculine people: ‘transgender, *transidentische*,¹ transsexual, and intersexual men, and all people whose gender entry is or used to be female but who feel improperly or incompletely described by this term’ (176–177, author’s translation). This definition explicitly includes intersex people in the transmasculine population, which challenges the assumption that all transmasculine people will present with an unambiguously ‘female’ physical sexual differentiation.

Methods to change vocal gender presentation

The large majority of the expert opinion papers mentioned hormone treatment (93%), 67% voice therapy, 27% laryngeal surgery, and 20% referred to transmasculine people’s own attempts at changing their vocal and communication behaviour. The effects of hormone treatment on transmasculine people’s vocal situations were examined in 14 of the 17 primary research studies (82%) and those of laryngeal surgery in two (12%) (Adler *et al.* 2012a, Kojima *et al.* 2008). One primary research study (6%) investigated the effects of voice therapy with transmasculine people (Söderpalm *et al.* 2004). The nature and effects of transmasculine people’s own attempts at changing their vocal gender presentation have not yet been examined in the literature (table 4).

Comprehensiveness of the examination of transmasculine people’s vocal situations

Only some gender-related aspects of transmasculine people’s vocal situations were addressed in the literature under review, and very few were found to have been thoroughly investigated. Ten of the 17 primary research studies were solely focussed on examining presentational factors affecting transmasculine people’s vocal situations (58%); two were solely focussed on attributional factors (12%); another two examined presentational and attributional factors (12%); one looked at presentational and normative factors (6%); and two examined all three factors (12%) (table 4).

Presentational factors

Reference to the dimensions of transmasculine people’s voice organs was made in all of the expert opinion papers (including vocal fold mass, larynx size, vocal fold length, vocal fold tension, and vocal tract length), but there were no primary research studies that included measurements of these dimensions. One expert opinion paper reported on a palpatory examination of the larynges of two transmasculine people (Adler *et al.* 2012a).

The following gender-related voice features were mentioned in the expert opinion papers: pitch (93%), resonance (47%), intonation (47%), voice quality (40%), and intensity (20%). Voice pitch was examined in 15 of the 17 primary research studies (88%), voice quality and formant frequencies each in two (12%) (table 4).

Attributional factors

Transmasculine people’s self-perception of voice with regards to gender was mentioned in one expert opinion paper (7%) and examined in three of the 17 primary research studies (18%). Gender attribution to transmasculine people’s voices by others was mentioned in 47% of the expert opinion papers and examined in six of the primary research studies (35%) (table 4).

Normative factors

In 14 of the 17 primary research studies (82%), the standards of masculinity and femininity that informed the interpretation of presentational and attributional aspects of transmasculine people’s vocal situations were not mentioned. In one study (Martin *et al.* 1984), authors specified the normative factors affecting all sub-investigations undertaken as part of their study, and in two studies (Scheidt *et al.* 2004, Van Borsel *et al.* 2009), authors specified the normative factors affecting some of the sub-investigations they undertook (table 4).

Evaluation of gender-related voice problems

The majority of the discursive and empirical data pertaining to gender-related voice problems in transmasculine people were focussed on problems resulting from testosterone treatment. Among the numerous problem areas that were identified in expert opinion papers and primary research studies, only the problem area ‘lack of change to voice pitch’ as a result of testosterone treatment received substantial attention. All other problem areas were found to be under-researched with reported results to be inconclusive.

Transmasculine people treated with testosterone

In 12 of the 15 expert opinion papers (80%), authors commented on the presence of gender-related voice problems in transmasculine people treated with testosterone. In three of these papers (20%), it was suggested that the gender-related aspects of the vocal situations of transmasculine people treated with testosterone can be regarded as unproblematic. In the remaining 12 papers (80%), authors mentioned problems that might be observed including: limited pitch lowering (three

Table 4. Examination of transmasculine people's vocal situations: factors investigated

Reference	Method to change gender presentation	Presentational factors		Attributional factors		Normative factors
		Perceptual evaluation	Acoustical evaluation	Self-perception	Gender attribution by others	
Damrose (2009)	HT		F_0			
Gooren and Giltay (2008)	HT	Pitch, voice quality				
Martin <i>et al.</i> (1984)	HT		F_0 , FF			×
Mueller <i>et al.</i> (2010)	HT	Pitch				
Nakamura <i>et al.</i> (2013)	HT	Pitch				
Pobisova <i>et al.</i> (1985)	HT	Pitch				
Scheidt <i>et al.</i> (2003, 2004)	HT		F_0 , FF	×	×	(×)
T'Sjoen <i>et al.</i> (2006)	HT			×	×	
Vague <i>et al.</i> (1984)	HT				×	
Van Borsel <i>et al.</i> (2000) ^a	HT	Pitch (SP)		×	×	
Van Borsel <i>et al.</i> (2000) ^b	HT		F_0 , jitter, shimmer			
Van Borsel <i>et al.</i> (2009)	HT		F_0		×	(×)
Yamasaki <i>et al.</i> (2003)	HT	Pitch				
Yuko <i>et al.</i> (2012)	HT	Pitch				
Adler <i>et al.</i> (2012a) ^a	LS		F_0		×	
Kojima <i>et al.</i> (2008)	LS		F_0			
Söderpalm <i>et al.</i> (2004)	VT		F_0			

Note: HT, hormone treatment; VT, voice therapy; LS, laryngeal surgery; (SP), self-perception; F_0 , average fundamental frequency; FF, formant frequencies; ×, examined; (×), partly examined; no entry = not examined.

papers); insufficient voice masculinization as perceived by transmasculine people themselves or others (four); failure to masculinize communication features other than voice pitch (three); insufficient masculinization of voice organ (one); voice masculinization from testosterone treatment imperceptible to transmasculine people (one).

Fifteen of the 17 primary research studies (88%) provided some empirical data on the presence of gender-related voice problems in transmasculine people treated with testosterone. In six of these studies (40%), the data provided suggested that the gender-related aspects of the vocal situations of transmasculine people treated with testosterone can be regarded as unproblematic. In the remaining nine studies (60%), authors provided details of problem areas pertaining to presentational and attributional factors affecting transmasculine people's vocal situations. These are analysed below.

Presentational factors. Data to assess the problem area 'lack of change to voice pitch' as a result of testosterone administration was provided in nine of the 17 primary research studies (table 5). In five studies (total $n = 55$), all participants were reported to have experienced a decrease in voice pitch as a result of testosterone administration, in another four studies (total $n = 1059$), a majority of participants reported this result. Authors of six studies reported that a 'deepening of voice' was observed but gave no information about the examination method used or the extent of the voice change that took place. In the remaining three studies, fundamental

frequency measures and a written survey were used to assess change.

The problem area 'insufficient lowering of voice pitch' as a result of testosterone treatment was addressed in six primary research studies (table 6). For all of these studies, average fundamental frequency measures (F_0) were reported. In three studies (total $n = 17$), the voices of the majority of participants were judged to be sufficiently lowered (i.e. $F_0 < 131$ Hz), while in three other studies (total $n = 7$), the results of all participants were judged as insufficiently lowered.

Three studies addressed potential problem areas pertaining to gender-related voice features other than fundamental frequency. Martin *et al.* (1984) compared the formant frequencies of three transmasculine participants with those of biological male and female controls and classified the formant frequencies of two participants as 'female' and those of one participant as 'male'. Scheidt *et al.* (2003) did not attempt a gender classification of the formant frequency measurements conducted as part of their study. Van Borsel *et al.* (2000) measured changes to vocal jitter and shimmer as a result of hormone treatment in two participants but could not show a tendency for shimmer to increase or jitter to decrease, which the authors would have interpreted as a sign of voice masculinization.

Attributional factors. Data to assess the problem area 'dissatisfaction with voice pitch' following testosterone treatment was provided in five primary research studies (table 6). In two studies ($n = 1$ and $n = 20$), all participants were reported as satisfied with their pitch

Table 5. Problem areas associated with testosterone treatment: presentational factors

Reference: (sample size, examination method)	Lack of change to voice pitch		Insufficient lowering of voice pitch (F0 > 131 Hz)	
	Observed (n,%)	Not observed (n,%)	Observed (n,%)	Not observed (n,%)
Adler <i>et al.</i> (2012a) ^a : (n = 1, F ₀)			1 (100%)	
Damrose (2009) (n = 1, F ₀)		1 (100%)		1 (100%)
Gooren and Giltay (2008) (n = 712, n.s.)	A few	'Almost all'		
Martin <i>et al.</i> (1984) (n = 3, F ₀)				3 (100%)
Mueller <i>et al.</i> (2010) (n = 45, n.s.)		45 (100%)		
Nakamura <i>et al.</i> (2013) (n = 138, n.s.)	3 (2%)	135 (98%)		
Pobisova <i>et al.</i> (1985) (n = 6, n.s.)		6 (100%)		
Scheidt <i>et al.</i> (2003, 2004) (n = 13, F ₀)			4 (31%)	9 (69%)
Van Borsel <i>et al.</i> (2000) (n = 2, F ₀)		2 (100%)	2 (100%)	
Van Borsel <i>et al.</i> (2000) (n = 16, survey)	2 (13%)	14 (87%)		
Van Borsel <i>et al.</i> (2009) (n = 4, F ₀)			4 (100%)	
Yamasaki <i>et al.</i> (2003) (n = 1, n.s.)		1 (100%)		
Yuko <i>et al.</i> (2012) (n = 193, n.s.)	6 (3%)	187 (97%)		

Note: F₀, average fundamental frequency; n.s., not specified; no entry = not examined.

Table 6. Problem areas associated with testosterone treatment: attributional factors (self-perception)

Reference (sample size)	Dissatisfaction with voice pitch		Inconsistency: self-perception of voice—subjective gender positioning	
	Observed (n,%)	Not observed (n,%)	Observed (n,%)	Not observed (n,%)
Adler <i>et al.</i> (2012a) ^a (n = 1)	1 (100%)			
Damrose (2009) (n = 1)		1 (100%)		
Scheidt <i>et al.</i> (2003, 2004) (n = 13)	3 (23%)	10 (77%)	6 (46%)	7 (54%)
T'Sjoen <i>et al.</i> (2006) (n = 20)		20 (100%)		
Van Borsel <i>et al.</i> (2000) (n = 16)	2 (13%)	14 (87%)	4 (25%)	12 (75%)

Note: No entry = not examined.

levels; in another two studies ($n = 13$ and $n = 16$), the majority of participants were satisfied, and in one study, the sole participant was dissatisfied.

The problem area 'inconsistency between self-perception of voice and subjective gender positioning' was addressed in two studies (table 6). In both studies ($n = 13$ and $n = 16$), the proportion of participants reporting inconsistency (46% and 25%) exceeded the proportion dissatisfied with their pitch levels (23%, 13%).

The problem area 'inconsistency between transmasculine people's subjective gender positionings and gender attributions by others' was addressed in five primary research studies (total $n = 54$, table 7). One study examined gender attribution over the phone ($n = 20$), and all participants reported agreement between how they were addressed and how they positioned themselves with regards to gender (T'Sjoen *et al.* 2006). In the remaining four studies (total $n = 34$), at least one in five participants (range 19–100%) reported that they were never, or not always, perceived as a member of the gender grouping to which they felt they belonged. Two of these studies compared gender attri-

butions among the same group of participants (total $n = 29$) across different settings (clinical setting, phone, everyday encounters, experimental setting) and found that the setting appeared to affect agreement between gender attributions and the participants' subjective gender positionings.

Transmasculine people treated with laryngeal surgery

Two studies provided data to assess potential problem areas pertaining to transmasculine people treated with laryngeal surgery. Adler *et al.* (2012a) reported a case of a transmasculine person who presented pre-surgery with an insufficiently lowered voice pitch despite two years of androgen therapy. Post-surgery the participant's average fundamental frequency fell consistently below 131 Hz, and on the telephone he was systematically perceived as a man. Kojima *et al.* (2008) reported a case of a transmasculine person who was only interested in pitch-lowering surgery and did not wish to be treated with testosterone. In this case, while the average fundamental frequency post-surgery remained above 131 Hz, the participant was reported to be satisfied with his voice.

Table 7. Problem areas associated with testosterone treatment: attributional factors (gender attribution by others)

Reference (sample size)	Inconsistency between transmasculine people's subjective gender positionings and gender attribution								
	By the assessing phoniatician		On the phone		In everyday encounters		By independent listeners		
	Observed (n,%)	Not Observed (n,%)	Observed (n,%)	Not Observed (n,%)	Observed (n,%)	Not Observed (n,%)	Observed (n,%)	Not Observed (n,%)	
Adler <i>et al.</i> (2012a) ^a (n = 1)			1 (100%)						
T'Sjoen <i>et al.</i> (2006) (n = 20)				20 (100%)					
Scheidt <i>et al.</i> (2004) (n = 12)	7 (58%)	5 (42%)							
Scheidt <i>et al.</i> (2003, 2004) (n = 13)			7 (54%)	6 (46%)					
Scheidt <i>et al.</i> (2003, 2004) (n = 13)							5 (38%)	8 (62%)	
Van Borsel <i>et al.</i> (2000) (n = 16)			4 (25%)	12 (75%)	3 (19%)	13 (81%)			
Van Borsel <i>et al.</i> (2009) (n = 4)							3 (75%)	1 (25%)	

Note: No entry = not examined.

Voice treatment with transmasculine people

Authors in 10 of 15 expert opinion papers (76%) acknowledged that transmasculine people may experience voice problems and recommended voice professionals offer services to transmasculine people. One primary research study (6%) (Söderpalm *et al.* 2004) reported data on voice treatment conducted with one participant for six months. Average fundamental frequency was lowered (148–113 Hz), vocal stability increased and vocal fatigue disappeared.

Discussion

While there has been a substantial increase in publications on transmasculine people in the voice literature in the last ten years, the research base examining gender-related aspects of transmasculine people's vocal situations was found to be small and somewhat limited. The literature search revealed an imbalance in terms of the number of publications exclusively concerned with transfeminine people's vocal situations compared with the concerns of transmasculine people. The comparison between the two different sets of articles that were analysed illustrated that the research has yet to catch up on examining most of the issues that were raised in the expert opinion papers. The overall quality of primary research studies was judged to be poor with the majority of findings ranked at the bottom of evidence hierarchies. Small sample sizes, lack of detail about methods used to change vocal gender presentation, and failure to specify examination methods, speech tasks, and normative values were found to limit comparability of results between studies and generalizability of findings. These findings taken together indicate that the evidence base for current practice to address transmasculine people's vocal situations is weak. More research attending to the complexity of the factors that contribute to a successful or unsuccessful vocal communication of gender in interaction needs to be conducted to improve the current state

of knowledge and to enable an evidence-based approach to specialized voice support for this diverse population.

Accounting for diversity

While the scope of consideration of the majority of the publications under review was limited to the transsexual section of the transmasculine community, authors in a small number of expert opinion papers acknowledged that transmasculine people position themselves diversely with regards to gender irrespective of whether they were formally diagnosed with 'female-to-male transsexualism'. However, this issue was demonstrated in only one small study. The findings from this literature review point to a need to better understand transmasculine people's subjective gender positionings and how this may affect their voice needs. If the heterogeneous nature of transmasculine people in terms of their subjective gender positioning and preferences for how they wish to be perceived and addressed is confirmed, it will be necessary to devise approaches for future research and clinical practice that can accommodate such diversity.

A high degree of inconsistency in the use of terminology when referring to transmasculine people was found between the publications in this review. In some publications, the terminology used disregarded participants' subjective gender positionings and expressed wishes not to be referred to as 'female'. Such an approach is problematic for several reasons. Using terminology that is disrespectful of the identity of those to whom it refers constitutes a breach of the principles of participant-centred research and client-centred clinical practice. Inconsistent use of terminology between professionals and with clients and significant others also impedes effective communication. More careful attention to the use of terminology in research publications and clinical practice involving the transmasculine community is recommended to ensure that communication

with and about transmasculine people is ethically informed.

While the majority of primary research studies in this review examined the effects of testosterone treatment on transmasculine people's vocal situations, authors in a few publications acknowledged that some transmasculine people may prefer other treatment methods to change their gender presentation. To better prepare voice clinicians for a diversity of support requests, more research effort needs to be dedicated to examining the benefits and limitations of voice therapy and laryngeal surgery for transmasculine people.

The issues raised in this literature review show that it may be necessary to aim for individualized or small-group approaches with transmasculine people as the homogeneity required for large-scale randomized controlled research studies is unlikely to be met among this population.

Comprehensiveness of the examination of transmasculine people's vocal situations

Of the numerous voice and communication features that past research found to be gender-related (e.g. see Oates and Dacakis 1997 for an overview), only some factors were examined in primary research studies with transmasculine people, and very few have been thoroughly investigated by voice researchers. Voice pitch, which is widely regarded as the key presentational aspect of vocal gender, received most attention but acoustical data were not always reported and speech tasks used were often not relevant to participants' everyday communication practices. The importance of the anatomical dimensions of transmasculine people's voice organs and of voice and communication characteristics other than pitch and voice quality was mentioned in several expert opinion papers but these factors have not yet been examined. Most primary research studies were limited to the examination of only one or two factors relevant to the evaluation of transmasculine people's vocal situations, and in several articles only group data were provided, preventing comparisons across different parts of an examination. Additionally, the following crucial factors determining the success of a transmasculine person's attempt at communicating the gender to which they feel they belong received comparatively little consideration in the voice literature to date: self-perception of voice with regards to gender; gender attributions by others; and the normative values used to evaluate different aspects of transmasculine people's voices.

These findings taken together indicate a lack of careful and comprehensive attention to the different factors that affect the gender-related aspects of transmasculine people's vocal situations and point to the necessity to de-

velop an approach to research and clinical practice that is informed by a theoretical perspective that does justice to the complexity of the processes that contribute to the production of gender in interaction.

Studies combining an examination of presentational, attributional, and normative factors, conducted in the participants' everyday communication settings, and using speech tasks that correspond to the participants' everyday communication activities are needed in the future in order to arrive at a better understanding of individual transmasculine people's specific voice problems and support needs.

Evaluation of voice problems transmasculine people may experience

Of the relevant aspects that affect transmasculine people's vocal situations, only the question of whether testosterone treatment leads to a change in voice pitch has received substantial attention. Several studies have shown the problem area 'lack of change to voice pitch' only affects a minority of transmasculine people while the reasons for missing responsiveness to testosterone have not yet been explored. All other areas of interest were found to be under-researched with reported results to be inconclusive.

In examining one of the claims that formed the starting point of this review (transmasculine people's vocal situations can be regarded as unproblematic because testosterone leads to an increase of vocal fold mass and voice changes that are tantamount to a voice masculinization), it was surprising to find that no controlled studies had been published to demonstrate that hormone treatment changes the dimensions of transmasculine people's voice organs. While, it was important to find that a majority of participants were satisfied with the pitch levels of their voices, existing studies do not provide sufficient evidence to conclude that testosterone-induced voice change is enough to enable a transmasculine person to be recognized by others as a male. Authors in several expert opinion papers also recommended voice therapy for transmasculine people, independent of the method used to change gender presentation. Some publications provided evidence of requests for laryngeal surgery in addition to, or instead of, hormone treatment.

The generalized claim that transmasculine people do not experience problems with the vocal communication of gender and therefore do not require attention from voice professionals cannot be supported from the evidence available. Rather, the involvement of voice specialists in the provision of support services for transmasculine people was identified.

Limitations of this review

This study was ambitious in its aim to review the published academic and clinical voice literature on transmasculine people. While the search terms aimed to identify all studies published in the area, it is possible that some studies, in particular those included in clinically oriented textbooks or published in languages other than English and German, were not identified. As a single-authored publication, this study is informed by one particular theoretical perspective on notions of 'sex', 'gender', 'voice', and their relationships, which influenced the choice of criteria for and the findings of the appraisal of the literature. It is possible that reviews conducted by researchers with different theoretical perspectives would focus on different aspects of the literature not sufficiently covered in this study.

Conclusion

More careful research into the different factors affecting transmasculine people's vocal situations needs to be conducted so that transmasculine people can be provided with reliable advice about the likelihood and nature of voice problems they may experience and be offered treatment that is suitable to support them in their endeavour of being perceived and addressed as a member of the gender grouping to which they feel they belong.

In order to improve the quality of the research base, findings from the review suggest that the following recommendations be considered in future studies with transmasculine people:

- Inclusion of an examination of participants' subjective gender positionings.
- Development of agreed terminology and taxonomy in consultation with transmasculine participants that is respectful of their self-descriptions and preferred form of address.
- Establishment of consensus in reporting relevant details of the methods used to change gender presentation that may affect the participants' vocal situations.
- Use of a variety of specified examination methods that address presentational, attributional, and normative aspects of the participants' vocal situations.
- Reporting of individual data in addition to group data in publications are needed to facilitate future meta-analyses.

At this exploratory stage of research in this area, well-defined smaller-scale case studies that aim at following an inclusive and comprehensive approach to the topic

may be preferable. Findings from such studies can be used to inform studies located at higher evidence levels.

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Note

1. 'Transidentisch' is a term used by transgender people for whom it is important to emphasize that their self-description focuses on gender identity rather than on sexuality or biological sex.

References

- ADLER, R. K., CONSTANSIS, A. N. and VAN BORSEL, J., 2012a, Female-to-male transgender/transsexual considerations. In R. K. Adler, S. Hirsch and M. Mordaunt (eds), *Voice and Communication Therapy for the Transgender/Transsexual Client: A Comprehensive Clinical Guide* (San Diego, CA: Plural), pp. 153–185.
- ADLER, R. K., HIRSCH, S. and MORDAUNT, M. (eds), 2012b, *Voice and Communication Therapy for the Transgender/Transsexual Client: A Comprehensive Clinical Guide* (San Diego, CA: Plural).
- ANTONI, C., 2007, The role of the speech and language therapist. In J. Barrett (ed.), *Transsexual and Other Disorders of Gender Identity* (Oxford: Radcliffe), pp. 139–156.
- AZUL, D., 2013a, The theory of doing gender: an enrichment for voice treatment with transgenders?. *Logos: Die Fachzeitschrift für akademische Sprachtherapie und Logopädie*, **1**, 4–14. [in German]
- AZUL, D., 2013b, How do voices become gendered? A critical examination of everyday and medical constructions of the relationship between voice, sex and gender identity. In M. Ah-King (ed.), *Challenging Popular Myths of Sex, Gender and Biology* (Cham: Springer), pp. 77–88.
- BÖHME, G., 1997, *Sprach-, Sprech-, Stimm- und Schluckstörungen: Ein Lehrbuch* (Stuttgart: Gustav Fischer).
- BRALLEY, R. C., BULL, G. L., GORE, C. H. and EDGERTON, M. T., 1978, Evaluation of vocal pitch in male transsexuals. *Journal of Communication Disorders*, **11**, 443–449.
- COLEMAN, E., BOCKTING, W., BOTZER, M., COHEN-KETTENIS, P., DECUYPERE, G., FELDMAN, J., FRASER, L., GREEN, J., KNUDSON, G., MEYER, W. J., MONSTREY, S., ADLER, R. K., BROWN, G. R., DEVOR, A. H., EHRBAR, R., ETTNER, R., EYLER, E., GAROFALO, R., KARASIC, D. H., LEV, A. I., MAYER, G., MEYER-BAHLBURG, H., HALL, B. P., PFAEFFLIN, F., RACHLIN, K., ROBINSON, B., SCHECHTER, L. S., TANGPRICHA, V., VAN TROTSENBURG, M., VITALE, A., WINTER, S., WHITTLE, S., WYLIE, K. R. and ZUCKER, K., 2012, Standards of care for the health of transsexual, transgender, and gender-nonconforming people: version 7. *International Journal of Transgenderism*, **13**, 165–232.
- CROMWELL, J., 1999, *Transmen and FTMs: Identities, Bodies, Genders, and Sexualities* (Urbana, IL: University of Illinois Press).
- DAMROSE, E. J., 2009, Quantifying the impact of androgen therapy on the female larynx. *Auris, Nasus, Larynx*, **36**, 110–112.

- DAVIES, S. and GOLDBERG, J. M., 2006, Clinical aspects of transgender speech feminization and masculinization. *International Journal of Transgenderism*, **9**, 167–196.
- DE BRUIN, M., COERTS, M. and GREVEN, A., 2000, Speech therapy in the management of male-to-female transsexuals. *Folia Phoniatrica et Logopaedica*, **52**, 220–227.
- DESCLOUX, P., ISOARD-NECTOUX, S., MATOSO, B., MATTHIEU-BOURDEAU, L., SCHNEIDER, F. and SCHWEIZER, V., 2012, Transsexuality: Speech therapy supporting the ‘voice’ of transformation. *Revue de Laryngologie Otologie Rhinologie*, **133**, 41–44. [in French]
- FEINBERG, L., 1996, *Transgender Warriors: Making History from Joan of Arc to Dennis Rodman* (Boston, MA: Beacon).
- GELFER, M. P., 1999, Voice treatment for the male-to-female transgendered client. *American Journal of Speech Language Pathology*, **8**, 201–208.
- GOOREN, L., 2005, Hormone treatment of the adult transsexual patient. *Hormone Research*, **64**, 31–36.
- GOOREN, L. J. G. and GILTAY, E. J., 2008, Review of studies of androgen treatment of female-to-male transsexuals: effects and risks of administration of androgens to females. *Journal of Sexual Medicine*, **5**, 765–776.
- HANSBURY, G., 2005, The middle men: an introduction to the trans-masculine identities. *Studies in Gender and Sexuality*, **6**, 241–264.
- ISSHIKI, N., TAIRA, T. and TANABE, M., 1983, Surgical alteration of the vocal pitch. *Journal of Otolaryngology*, **12**, 335–40.
- JOANNA BRIGGS INSTITUTE, 2013, *The JBI Approach: Levels of Evidence* (available at: <http://joannabriggs.org/jbi-approach.html#tabbed-nav=Levels-of-Evidence>) (accessed on 15 November 2013).
- KESSLER, S. J. and MCKENNA, W., 1978, *Gender: An Ethnomethodological Approach* (New York, NY: Wiley).
- KESSLER, S. and MCKENNA, W., 2000, Who put the ‘trans’ in transgender? Gender theory and everyday life. *International Journal of Transgenderism*, **4** (available at: <http://www.iiv.nl/eazines/web/ijt/97-03/numbers/symposion/kessler.htm>) (accessed on 24 November 2013).
- KOJIMA, T., SHOJI, K., ISSHIKI, N. and NAKAMURA, K., 2008, Thyroplasty Type III for treatment of voice problem in GID of female-to-male type. *Practica Oto-Rhino-Laryngologica*, **101**, 39–43. [in Japanese]
- MARTIN, F., KLINGHOLZ, F. and EICHER, W., 1984, Evaluation of pitch and voice quality in transsexuals. *HNO*, **32**, 24–27. [in German]
- MCNEILL, E. J., WILSON, J. A., CLARK, S. and DEAKIN, J., 2008, Perception of voice in the transgender client. *Journal of Voice*, **22**, 727–733.
- MOERMAN, M., VERMEERSCH, H., VAN BORSEL, J. and WALLAERT, P., 2000, Phonosurgery in gender dysphoria. *Acta chirurgica Belgica*, **100**, 58–61.
- MOORE, E., WISNIEWSKI, A. and DOBS, A., 2003, Endocrine treatment of transsexual people: a review of treatment regimens, outcomes, and adverse effects. *Journal of Clinical Endocrinology and Metabolism*, **88**, 3467–3473.
- MUELLER, A., HAEBERLE, L., ZOLLNER, H., CLAASSEN, T., KRONAWITTER, D., OPPELT, P. G., CUPISTI, S., BECKMANN, M. W. and DITTRICH, R., 2010, Effects of intramuscular testosterone undecanoate on body composition and bone mineral density in female-to-male transsexuals. *Journal of Sexual Medicine*, **7**, 3190–3198.
- NAKAMURA, A., WATANABE, M., SUGIMOTO, M., SAKO, T., MAHMOOD, S., KAKU, H., NASU, Y., ISHII, K., NAGAI, A. and KUMON, H., 2013, Dose–response analysis of testosterone replacement therapy in patients with female to male gender identity disorder. *Endocrine Journal*, **60**, 275–281.
- NEUSCHAEFER-RUBE, C., SCHEIDT, D. and GROSS, D., 2008, Models for the definition of transsexualism and their effects on social acceptance—the example of voice and speech behaviour. In D. Groß, S. Müller and J. Steinmetzer (eds), *Normal – anders – krank? Akzeptanz, Stigmatisierung und Pathologisierung im Kontext der Medizin* (Berlin: Medizinisch Wissenschaftliche Verlagsgesellschaft), pp. 171–194. [in German]
- OATES, J. and DACAKIS, G., 1997, Voice change in transsexuals. *Venerology*, **10**, 178–187.
- PARKER, A. J., 2008, Aspects of transgender laryngeal surgery. *Sexologies*, **17**, 277–282.
- PÉREZ ALVAREZ, J. C., 2011, Voice and identity in transsexuality. *Handchirurgie Mikrochirurgie Plastische Chirurgie*, **43**, 246–249. [in German]
- PETTIT, J. M., 2004, Transsexualism and sex reassignment: speech differences. In R. D. Kent (ed.), *The MIT Encyclopedia of Communication Disorders* (Cambridge, MA: MIT Press), pp. 223–225.
- POBISOVA, Z., HERESOVA, J. and SIPOVA, I., 1985, Administration of androgens to transsexual females: I. Effect on somatometric parameters. *Casopis Lekarů Ceskych*, **124**, 614–617. [in Czech]
- ROSANOWSKI, F. and EYSHOLDT, U., 1999, Medical expertise prior to voice change surgery in male-to-female transsexuals. *HNO*, **47**, 556–562. [in German]
- SCHEIDT, D., KOB, M. and NEUSCHAEFER-RUBE, C., 2003, On the vocal situation of so-called female-to-male transsexuals: self-perception, other perception and acoustical data regarding gender presentation. In M. Gross and E. Kruse (eds), *Aktuelle phoniatrisch-pädaudiologische Aspekte 2003/2004* (Niebüll: Videel), pp. 172–177. [in German]
- SCHEIDT, D., KOB, M., WILLMES, K. and NEUSCHAEFER-RUBE, C., 2004, Do we need voice therapy for female-to-male transsexuals? In B. E. Murdoch, J. Goozee, B.-M. Whelan and K. Docking (eds), *2004 IALP Congress Proceedings* (Brisbane, QLD: Speech Pathology Australia).
- SCHÜCHNER, D., 2000, Transsexuality and speech–language pathology: the path to a new voice—part 2. *Logopädie*, **3**, 11–16. [in German]
- SÖDERPALM, E., LARSSON, A. K. and ALMQUIST, S., 2004, Evaluation of a consecutive group of transsexual individuals referred for vocal intervention in the west of Sweden. *Logopedics Phoniatrics Vocology*, **29**, 18–30.
- SPIEGEL, J. H., 2006, Phonosurgery for pitch alteration: feminization and masculinization of the voice. *Otolaryngologic Clinics of North America*, **39**, 77–86.
- T’SJOEN, G., MOERMAN, M., VAN BORSEL, J., FEYEN, E., RUBENS, R., MONSTREY, S., HOEBEKE, P., DE SUTTER, P. and DE CUYPERE, G., 2006, Impact of voice in transsexuals. *International Journal of Transgenderism*, **9**, 1–7.
- THORNTON, J., 2008, Working with the transgender voice: the role of the speech and language therapist. *Sexologies*, **17**, 271–276.
- VAGUE, J., MEIGNEN, J. M. and NEGRIN, J. F., 1984, Effects of testosterone and estrogens on deltoid and trochanter adipocytes in two cases of transsexualism. *Hormone and Metabolic Research*, **16**, 380–381.
- VAN BORSEL, J., DE CUYPERE, G., RUBENS, R. and DESTAERKE, B., 2000, Voice problems in female-to-male transsexuals. *International Journal of Language and Communication Disorders*, **35**, 427–442.
- VAN BORSEL, J., DE POT, K. and DE CUYPERE, G., 2009, Voice and physical appearance in female-to-male transsexuals. *Journal of Voice*, **23**, 494–497.

WORLD HEALTH ORGANISATION, 2010, *International Statistical Classification of Diseases and Related Health Problems 10th Revision* (available at: <http://apps.who.int/classifications/icd10/browse/2010/en>) (accessed on 28 October 2013).

YAMASAKI, H., DOUCHI, T. and NAGATA, Y., 2003, Changes in anthropometry with testosterone therapy in a female

with gender identity disorder. *Endocrine Journal*, **50**, 729–731.

YUKO, M., MORITO, S., MASAMI, W., HIROMI, K., KAZUSHI, I. and TOMOKO, S., 2012, The optimal dose of testosterone enanthate for the patients with female to male gender identity disorders. *International Journal of Urology*, **19**, 204.