

## Supplemental Material S1. Psychosocial mechanisms: empirical studies.

Author(s), Year	Label	Criteria for MTD-1 diagnosis	Study groups	Assessment measures relevant to the psychosocial category	Main results for the psychosocial category
Andrea et al., 2017	Muscle tension voice disorder	<p>Presence of dysphonia despite normal anatomy and movement</p> <p>MTVD1: Posterior glottal gap, medial and A-P glottal compression, reduced VF amplitude</p> <p>MTVD2: Structural changes in VFs lead to excessive laryngeal effort and to MTVD</p>	<p>G1: 39 people with psychogenic voice disorder</p> <p>G2: 16 people with MTVD1</p> <p>G3: 28 people with MTVD2</p>	<p>Hamilton Depression Rating Scale (HAM-D)</p> <p>Hamilton Anxiety Rating Scale (HARS)</p> <p>Mini International Neuropsychiatric Interview (MINI)</p>	<p>Patients with MTDV1 had significantly higher mean depression (HAM-D, <math>p = .002</math>) and anxiety (HARS, <math>p = .001</math>) scores than the other two groups.</p> <p>MINI (affective disorders): significant associations were found between group and current major depression (<math>p = .050</math>) and current mood disorder with psychotic symptoms (<math>p = .045</math>). The MTDV1 group had a higher percentage than other groups for both diagnoses.</p> <p>MINI (anxiety disorders): MTVD1 group had significantly more patients than expected with lifetime panic disorder (<math>p = .009</math>), and current panic disorder with agoraphobia (<math>p = .013</math>). MTVD2 group with fewer than expected current generalized anxiety (<math>p = .040</math>).</p> <p>-MINI: Lifetime psychotic disorder symptoms: MTVD2 fewer patients than expected (<math>p = .031</math>)</p>
Baker et al., 2014	<p>Muscle tension voice disorder</p> <p>MTVD1 (without</p>	MTVD1: Palpable tension (intrinsic and extrinsic laryngeal muscles)	<p>G1: 10 people with MTVD1</p> <p>G2: 10 people with MTVD2</p>	Illness Behavior Questionnaire-31 (IBQ-31)	IBQ-31 affirmation of illness score: As a combined group, MTVD1 and MTVD2 scored higher than the comparison group ( $p \leq .05$ ).

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	secondary pathology)  MTVD2 (with secondary pathology)	Voice quality is breathy, rough, and/or strained Posterior glottal gap False vocal fold can be involved	G3: 20 vocally healthy controls, matched to G1 and G2	Levels of Emotional Awareness Scale (LEAS)  The Brief COPE (Carver, 1997)  Toronto Alexithymia Scale-20 (TAS-20)	LEAS total score: Combined control groups had a higher score than the combined MTVD groups, although significance was not reached ( $p = .06$ ).  COPE adaptive coping score: MTVD2 scored higher (more adaptive coping skills) than MTVD1 and their own matched controls ( $p \leq .05$ ).  COPE maladaptive coping score: MTVD2 scored higher (more maladaptive coping skills) than MTVD1 and both comparison groups ( $p \leq .01$ ).  TAS total score: MTVD1 had greater alexithymia than MTVD2 and their corresponding control group ( $p \leq .05$ ).
Buck et al., 2007	Functional dysphonia	Dysphonia complaint Absence of vocal fold pathology	G1: 40 people with functional dysphonia  G2: 10 people with dysphonia due to benign, organic causes	Illness Perception Questionnaire (IPQ)  Voice Perception Questionnaire (VPQ)  Hospital Anxiety and Depression Scale (HADS)  GRBAS score	Data below are correlations of IPQ domains with other IPQ domains and correlations of IPQ domains with other assessments. All correlations reported to be significant. No $p$ values reported.  IPQ: With increased duration of dysphonia, FD patients thought the dysphonia would last longer overall ( $r = .55$ ); also associated with an increase in perceived consequences ( $r = .44$ ).

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					<p>IPQ and GRBAS: Higher severity on G of GRBAS correlated with perceptions of greater consequences of FD (<math>r = .41</math>).</p> <p>IPQ and HADS: anxiety was only found in the FD group. An increase in anxiety was associated with an increase in perceived consequences (.36) and perceived duration of the voice problem (.39). With greater perception of internal or chance etiology of FD, anxiety was less (<math>r = -.33</math> and <math>-.35</math>, respectively).</p> <p>IPQ and VPQ: scores on the VPQ were correlated with an increased perception of consequences for both groups (.58).</p> <p>Descriptive statistics: On HADS, 17% of FD group with clinical anxiety, 2% with clinical depression; compared to none in the organic group.</p>
Dietrich et al., 2008	Primary muscle tension dysphonia	A voice disorder without an organic etiology (LPR was accepted as a comorbidity)	<p><i>(Retrospective)</i></p> <p>G1: 28 people with MTD-1</p> <p>G2: 40 people with vocal fold nodules</p> <p>G3: 30 patients with PVFMD</p>	<p>Perceived Stress Scale-10 (PSS-10)</p> <p>Hospital Anxiety and Depression Scale (HADS)</p>	<p>PSS-10: 28.6% of participants with primary MTD had z scores <math>\geq 1</math> above the norm (women, 29.2% and men, 25.0%). None of the diagnostic groups differed from each other on the PSS-10 (<math>p = .100</math>). Groups with primary diagnosis of MTD-1 or PVFMD had the greatest standard deviations.</p> <p>HADS – Anxiety subscale: Patients with primary diagnosis of MTD or PVFMD had the most variable data. Percentage-wise, 42.9% of patients with primary MTD had z scores <math>\geq 1</math> above the norm (women, 45.8% versus men, 25.0%). No significant differences between</p>

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			G4: 62 people with glottal insufficiency		<p>patients with MTD-1 and the other groups. G4 had lower scores than G2 (<math>p = .018</math>) and G3 (<math>p = .004</math>)</p> <p>HADS – Depression subscale: 28.6% of patients with primary MTD had z scores <math>\geq 1</math> above the norm (women, 33.3%; men, 0.0%). No significant differences were found between diagnosis groups.</p>
Falanga et al., 2020	Primary muscle tension dysphonia	Absence of organic pathology Absence of neurologic or psychogenic etiology “Excessive, atypical or abnormal laryngeal movements during phonation”	<p>G1: 100 people with voice disorders</p> <p>G1a: 60 people with MTD1</p> <p>G1b: 40 people with vocal fold nodules</p> <p>G2: 100 people vocally healthy matched controls</p>	<p>State Anxiety Inventory (STAI-1)</p> <p>Trait Anxiety Inventory (STAI-2)</p> <p>Perceived Stress Scale (PSS-10)</p> <p>Voice Handicap Index (Italian version) (VHI)</p> <p>Beck’s Depression Inventory (BDI)</p>	<p>Patients 18–35 years of age with vocal fold nodules had higher VHI scores than “older” patients with MTD-1 (<math>p = .005</math>).</p> <p>Patients with vocal fold nodules had higher total and subtotal (P and E only) scores on the VHI than people with MTD1 (<math>p &lt; .005</math>).</p> <p>Patients with vocal fold nodules had higher scores on the PSS-10 and STAI-1 than patients with MTD-1 (<math>p = .007</math> and <math>p = .028</math>, respectively).</p> <p>There was no significant difference in BDI scores between patients with MTD-1 and vocal fold nodules.</p> <p>Patients with voice disorders had significantly more severe scores on the PSS-10 (<math>p &lt; .0001</math>) and STAI-2 (<math>p &lt; .01</math>) compared with people who were vocally healthy.</p>

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Haselden et al., 2009	Functional dysphonia	Hoarseness Absence of organic pathology	G1: 19 people with spasmodic dysphonia – all three types represented  G2: 19 people with functional dysphonia  G3: 19 people with nonlaryngeal dystonia	Form C of the Multidimensional Health Locus of Control Scales	FD group had significantly higher <i>Internal</i> locus of control when compared to the spasmodic dysphonia group ( $p = .0004$ ) and the nonlaryngeal dystonia group ( $p = .0001$ ). The between-groups differences were no longer significant when the effects of <i>age</i> and <i>time with condition</i> were taken into account. FD internal locus of control was not abnormally high compared with normative data.  No significant differences between groups were found for <i>Chance</i> locus of control and <i>Powerful Others</i> locus of control.
House & Andrews, 1988	Functional dysphonia	Abnormal voice production which cannot be attributed to either laryngeal structural or neurological problems.	( <i>Retrospective</i> )  G1: 66 people with functional dysphonia  G2: 382 vocally healthy controls who were not depressed (historical)	Bedford College Life Events and Difficulties Schedule (LEDS)  Conflict Over Speaking Out calculations (COSO) (Developed within this study)	There was no difference between groups regarding events and difficulties in the year prior to dysphonia onset (difference in proportions: 3%, $p$ -value not reported).  More FD patients had COSO events in the year prior to or at dysphonia onset when compared to vocally healthy controls (54% vs 16%). Difference in COSO proportions between FD and vocally healthy was 38%, 95% CI = (22–54%); no $p$ -value reported.
Kridgen et al., 2021	Nonphono-traumatic hyperfunction (NPVH)	No structural or neurological disorder affecting the larynx	( <i>Retrospective</i> )  G1: 1577 patients with phonotraumatic vocal	Case history form questions related to voice disorder onset	Patients with NPVH reported a sudden onset of dysphonia more frequently than patients with PVH ( $p < .001$ , OR = 1.7).  Events associated with onset: “voice use” was reported more frequently in PVH group ( $p < .001$ , OR = 3.9)

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			hyperfunction (PVH) G2: 979 patients with NPVH		“anxiety/stress” and “URI” were reported by both groups, with no significant difference. However, “URI only” and “anxiety/stress only” were reported more frequently in the NPVH group ( $p < .001$ , OR = 2.1 and $p < .001$ , OR = 3.4, respectively).
Mirza et al., 2003	Functional dysphonia	Not specified	G1: 17 people with functional dysphonia  G2: 14 people with spasmodic dysphonia  G3: 11 people with vocal fold paralysis	Voice Handicap Index (VHI)  Brief Symptom Inventory (BSI)	29.4% (5/17) of those with functional dysphonia also had major psychiatric disorders based on the BSI – compared with 7.1% in the spasmodic dysphonia group and 63.6% in the vocal paralysis group (chi squared $p < .01$ ).  VHI and BSI scores did not positively correlate (no $p$ reported.)  Five of the patients with functional dysphonia and positive BSI scores demonstrated high interpersonal sensitivity and estrangement/distrust of others. Interpersonal symptoms were more severe than anxiety and depression for four of these people.
Montgomery et al., 2016	Functional dysphonia	Not specified	G1: 96 people with functional dysphonia  G2: 81 people with organic laryngeal disorders	Voice Symptom Scale (VoiSS) emotional subscale  Hospital Anxiety and Depression Scale (HADS)	Descriptive results: FD group had lower emotional VoiSS score when compared to the organic pathology group. FD group had lower HADS subscale scores when compared to the organic pathology group.
O’Hara et al., 2011	Functional dysphonia	Dysphonia or aphonia not attributable to organic pathology	G1: 75 people with functional dysphonia	The Chalder Fatigue Questionnaire	People with FD were significantly more fatigued than vocally healthy people when

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		or out of scale, severity-wise, with observed organic pathology.	G2: 62 vocally healthy people	Multidimensional Perfectionism Scale	<p>data were analyzed using Likert scale (<math>p = .009</math>) and binomial score (<math>p = .003</math>).</p> <p>People with FD demonstrated more perfectionism than vocally healthy people (<math>p = .043</math>).</p> <p>There was no significant difference between groups for healthy and unhealthy perfectionism specifically.</p>
Piersiala et al., 2021	Muscle tension dysphonia	Not reported	<p><i>(Retrospective)</i></p> <p>G1: 836 voice patients with mental health disorder (210 with MTD)</p> <p>G2: 3,413 voice patients no mental health disorder (745 with MTD)</p>	Search for ICD-10 codes per mental disorders	Among voice patients, those with depression were more likely to present with MTD than patients without depression (OR = 1.267, $p = .023$ ).
Piersiala et al., 2020	Muscle tension dysphonia	Not reported	<p><i>(Retrospective)</i></p> <p>G1: 215 voice patients with at least chronic pain syndrome (CPS), either fibromyalgia syndrome (FMS), irritable bowel</p>	Search for ICD-10 codes per CPS.	<p>People with CPS were more likely to have a MTD than controls (OR, 1.748 adjusting for sex and age).</p> <p>More specifically, people with FMS were at least twice likely to present with MTD when compared to healthy controls (OR, 2.338).</p>

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			syndrome, or chronic fatigue syndrome  G2: 4034 voice patients without a CPS		
Roy et al., 1997	Functional dysphonia	Voice disturbance which cannot be attributed to a visible structural or neurological problem	G1: 25 people with functional dysphonia (successfully treated with voice therapy)  G2: 19 people with physical medical problems not related to voice	Minnesota Multiphasic Personality Inventory (MMPI)	32% of FD group had “normal” MMPI scores versus 90% of the control group.  FD group had higher scores than the control group in the MMPI clinical scales Hypochondriasis ( $p < .0001$ ), Depression ( $p < .0001$ ), Hysteria ( $p < .0040$ ), Paranoia ( $p < .0430$ ), Psychasthenia ( $p < .0001$ ), Schizophrenia ( $p < .0001$ ), Social Introversion ( $p < .0098$ ). A statistical model containing the clinical scales Hypochondriasis and Psychasthenia differentiated FD from controls.
Roy et al., 2000b	Functional dysphonia	A voice disorder without evidence of neurological or structural pathology accounting for the problem	G1: 45 people with functional dysphonia (FD)  G2: 37 people with vocal nodules (VN)  G3: 35 people with adductor spasmodic dysphonia (SD)	Eysenck Personality Questionnaire - <i>Extraversion</i> - <i>Neuroticism</i> - <i>Psychoticism</i> - <i>Lie scale</i>  State-Trait Anxiety Inventory – Trait Scale  Beck Depression Inventory	Eysenck Personality results: FD lower in Extraversion (E) than VN group ( $p < .0001$ ) and healthy controls ( $p < .0011$ ). FD higher in Neuroticism (N) than SD ( $p < .0027$ ), UVFP ( $p < .0069$ ), controls ( $p < .0006$ ), and VN (not significant, $p = .071$ ). FD lower in Psychoticism (P) than VN ( $p < .0101$ ). FD scored higher than VN on the Lie (L) scale ( $p < .002$ ).



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			G4: 15 people with unilateral vocal fold paralysis (UVFP)  G5: 37 vocally normal controls	Voice Handicap Profile	In three separate statistical models, E and L differentiated FD and VN ( $p < .0001$ ); E and N differentiated FD and controls ( $p < .0001$ ); N separated FD from SD ( $p < .0058$ ) and UVFP ( $p < .018$ ).  STAI-Trait results: FD had more trait anxiety than controls ( $p < .0001$ ), VN ( $p < .0141$ ), SD ( $p < .0021$ ), and UVFP ( $p < .0029$ ).  Beck Depression Inventory results: On rank-transformed data, FD reported greater number of symptoms than the vocally healthy controls ( $p < .025$ ), VN ( $p < .033$ ), and SD ( $p < .013$ ). With age as covariate, the difference with VN was no longer significant.
Roy et al., 2000a	Functional dysphonia	A voice disorder without evidence of neurological or structural pathology accounting for the problem	G1: 45 people with functional dysphonia (FD)  G2: 37 people with vocal nodules (VN)  G3: 35 people with adductor spasmodic dysphonia (SD)  G4: 15 people with unilateral	Multidimensional Personality Questionnaire (MPQ): -Positive Emotionality -Negative Emotionality -Constraint  Voice Handicap Profile	MPQ Superfactors: In the FD group, <i>Positive Emotionality</i> was significantly lower than VN ( $p < .012$ ). It was also lower than controls, but not significantly ( $p < .0612$ ).  In the FD group, <i>Negative Emotionality</i> was significantly higher than controls ( $p < .0011$ ), VN ( $p < .0308$ ), SD ( $p < .0014$ ), and UVFP ( $p < .004$ ).  In the FD group, <i>Constraint</i> was significantly higher than VN ( $p < .0001$ ) and controls

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			vocal fold paralysis (UVFP)  G5: 37 people without voice disorders		<p>(ranked <math>p &lt; .036</math>). When age added as covariate, FD had significantly more <i>Constraint</i> than UVFP (<math>p &lt; .038</math>) but not controls (<math>p &lt; .11</math>).</p> <p>Within a statistical model, FD had higher <i>Constraint</i> than VN (<math>p &lt; .0001</math>) and higher <i>Negative Emotionality</i> than the controls, SD, and UVFP (<math>p &lt; .0029</math>, <math>p &lt; .002</math>, <math>p &lt; .0021</math>, respectively).</p> <p>MPQ Primary scales:  <i>Wellbeing</i> – FD significantly lower than controls (<math>p &lt; .005</math>), VN (<math>p &lt; .047</math>), SD (<math>p &lt; .016</math>), and UVFP (<math>p &lt; .0061</math>).</p> <p><i>Social Potency</i> – FD significantly lower than VN (<math>p &lt; .0001</math>) and controls (<math>p &lt; .055</math>).</p> <p><i>Social Closeness</i> – FD significantly lower than VN (<math>p &lt; .004</math>), UVFP (<math>p &lt; .046</math>), and controls (<math>p &lt; .03</math>).</p> <p><i>Stress Reaction</i> – FD significantly higher than control (<math>p &lt; .0001</math>), VN (<math>p &lt; .0023</math>), SD (<math>p &lt; .0007</math>), and UVFP (<math>p &lt; .0001</math>).</p> <p><i>Alienation</i> – FD significantly higher than SD (<math>p &lt; .0064</math>) and UVFP (<math>p &lt; .048</math>).</p>

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					<p><i>Aggression</i> – FD significantly lower than VN (<math>p &lt; .029</math>), but not when age was added as a covariate.</p> <p><i>Control</i> – FD significantly higher than VN (<math>p &lt; .0001</math>).</p> <p>A statistical model containing the MPQ primary scales <i>Social Potency</i>, <i>Achievement</i>, <i>Stress Reaction</i>, and <i>Control</i> differentiated FD from VN (<math>p &lt; .0001</math>). With age as covariate, <i>Stress Reaction</i> dropped out of the model.</p> <p>MPQ correlation with VHP: FD scores on <i>Absorption</i> scale correlated with total handicap score (<math>p &lt; .0078</math>).</p>
Siupsinskiene et al., 2011	Nonorganic dysphonia/ Primary muscle tension dysphonia	Voice complaints Muscle tension in the head and neck region No organic pathology	<p>G1: 69 people with Reinke’s edema</p> <p>G2: 51 people with vocal fold nodules</p> <p>G3: 84 people with vocal fold polyps</p> <p>G4: 27 people with laryngeal papillomatosis</p>	Hospital Anxiety and Depression Scale (HADS)	Patients with nonorganic dysphonia had greater anxiety scores on the HADS when compared to controls ( $p < .005$ ). Mean depression scores were not significantly different between the nonorganic dysphonia group and vocally healthy controls.

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			<p>G5: 88 people with laryngopharyngeal reflux</p> <p>G6: 44 people with vocal fold paralysis</p> <p>G7: 74 people with nonorganic dysphonia (84% with primary muscle tension dysphonia)</p> <p>G8: 88 vocally healthy people</p>		
van Mersbergen et al., 2008	Functional dysphonia	Dysphonia characterized by extraneous muscular activity during phonation without evidence of anatomical, mucosal, or peripheral neurological problems	<p>G1: 12 people with functional dysphonia (FD)</p> <p>G2: 19 people with social anxiety (SA)</p> <p>G3: 23 people who were vocally healthy and lacked psychological problems</p>	<p>Multidimensional Personality Questionnaire – Brief Form (MPQ-BF)</p> <p>State-Trait Anxiety Inventory (STAI)</p> <p>Beck Depression Inventory (BDI)</p> <p>Voice Handicap Index (VHI)</p> <p>Liebowitz Social Anxiety Scale (LSAS)</p>	<p>Pre-experimental measures: FD significantly higher than SA in overall MPQ-BF Positive Emotionality (including subscales Well-Being, Social Closeness, Social Potency); lower than SA in Negative Emotionality (including subscale Alienation) (<math>p &lt; .05</math>).</p> <p>With STAI, FD lower than SA on total score and State and Trait subscales (<math>p &lt; .05</math>)</p> <p>FD lower than SA on the BDI, Total LSAS (including Fear and Avoidance subscales); but</p>

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				<p>Self-Assessment Manikin rating of arousal</p> <p>Self-Assessment Manikin rating of valence</p> <p>Borg CR-10</p> <p>EMG</p> <p>Heart rate</p>	<p>higher than SA on VHI Total (including all three subscales) (<math>p &lt; .05</math>).</p> <p>FD significantly higher than HC on LSAS Total (including Fear subscale) and VHI Total (including all three subscales) (<math>p &lt; .05</math>).</p> <p>Assessment during imagery: EMG – FD group had less corrugator activation in aversive trial versus positive and neutral trials (post hoc).</p> <p>FD group had less submental muscle activity in affect scripts vs neutral scripts (<math>p = .009</math>).</p> <p>FD had higher heart rate during aversive and positive scripts when compared to baseline (<math>p = .013</math>).</p> <p>FD group had less submental muscle activity for the speech and nonverbal scripts versus neutral ones, whereas the SA and HC groups had greater activity (<math>p = .046</math>).</p> <p>During the aversive, neutral, and positive inductions, FD rated perceived effort significantly higher than HC (post hoc).</p> <p>FD reported greater vocal effort than HC with speech and neutral scripts (post hoc).</p>

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					<p>Post-mood induction:</p> <p>FD reported positive speech scripts significantly more pleasant compared to positive nonverbal scripts (<math>p = .025</math>).</p> <p>FD reported greater vocal effort after aversive speech scripts compared with aversive nonverbal scripts (<math>p = .044</math>).</p>

*Note.* MTDV = muscle tension voice disorder; HAM-D = Hamilton Depression Rating Scale; HARS = Hamilton Anxiety Rating Scale; MINI = Mini International Neuropsychiatric Interview; LEDS = Life Events and Difficulties Schedule; IBQ-31 = Illness Behavior Questionnaire-31; LEAS = Levels of Emotional Awareness Scale; TAS-20 = Toronto Alexithymia Scale-20; IPQ = Illness Perception Questionnaire; VPQ = Voice Perception Questionnaire;  $r$  = Pearson correlation coefficient; PSS-10 = Perceived Stress Scale-10; LPR = laryngopharyngeal reflux; PVFMD = paradoxical vocal fold movement disorder; STAI-1 = State Anxiety Inventory; STAI-2 = Trait Anxiety Inventory; VHI = Voice Handicap Index; BDI = Beck’s Depression Inventory; FD = functional dysphonia; COSO = conflict over speaking out; NPVH = nonphonotraumatic vocal hyperfunction; PVH = phonotraumatic vocal hyperfunction; BSI = Brief Symptom Inventory; VoiSS = Voice Symptom Scale; CPS = chronic pain syndrome; FMS = fibromyalgia syndrome; MMPI = Minnesota Multiphasic Personality Inventory; VN = vocal nodules; SD = spasmodic dysphonia; UVFP = unilateral vocal fold paralysis; MPQ = Multidimensional Personality Questionnaire; E = extraversion; N = neuroticism; P = psychoticism; L = lie scale; SA = social anxiety.