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RESEARCH REPORT

Speech and language therapists' management practices, perceived effectiveness of current treatments and interest in neuromuscular electrical stimulation for acquired dysarthria rehabilitation: An international perspective

Pasquale Balzan[1] | **Rebecca Palmer**[2] | **Catherine Tattersall**[1]

[1]Division of Human Communication Sciences, School of Allied Health Professions, Nursing and Midwifery, University of Sheffield, Sheffield, UK

[2]Sheffield Centre for Health and Related Research, University of Sheffield, Sheffield, UK

Correspondence
Pasquale Balzan, Division of Human Communication Sciences, School of Allied Health Professions, Nursing and Midwifery, University of Sheffield, Sheffield, S10 2TS, UK.
Email: pbalzan1@sheffield.ac.uk

Abstract

Background: Research is beginning to shed light on the practices employed by speech-language therapists (SLTs) for the management of acquired dysarthria. However, studies that explore SLTs' satisfaction with the effectiveness of current therapies and their interest in new treatment methods for this population have not been carried out. One potential new method is neuromuscular electrical stimulation (NMES): the pool of evidence for its use in rehabilitation is increasing, yet it has not been widely explored for use with dysarthria.

Aim: To extend the understanding of acquired dysarthria management practices employed by SLTs across the globe and determine their satisfaction with current therapy options. To explore their interest in using NMES with this population.

Methods and Procedures: A cross-sectional international online survey was developed and disseminated to SLTs working with adults with acquired dysarthria through international professional associations. The survey collected information on demographic characteristics, dysarthria management practices, satisfaction with treatment effectiveness and interest in and knowledge of NMES. Survey responses were analysed using descriptive and inferential statistics, and quantitative content analysis.

Outcomes and Results: A total of 211 SLTs (North America, 48.8%; Europe, 36%; Asia, 8.1%; Oceania, 5.7%; Africa, 0.9%; South America, 0.5%) completed the survey in full. Management practices varied considerably. There was a clear preference for informal assessments, mainly oral-motor examinations, focusing on body functions and structures. The majority of respondents rejected the use of non-speech oral motor exercises as a clinical or carryover exercise. Variable satisfaction with current speech subsystem treatments was noted; however, overall, there was a general dissatisfaction. Whilst a strong interest in the use of NMES for dysarthria was evidenced, it was noted that most SLTs lacked fundamental knowledge of NMES principles and application.

Conclusion: SLTs' management practices and satisfaction with acquired dysarthria treatments differed substantially. Investigations of the potential use of NMES for dysarthria treatment are of interest.

KEYWORDS
dysarthria, neuromuscular electrical stimulation, speech and language therapy, survey

WHAT THIS PAPER ADDS

What is already known on the subject

- Recent country-specific surveys have explored speech-language therapists' (SLTs') assessment and intervention practices for acquired dysarthria. These studies indicate that although clinical management for this speech disorder mainly involves informal assessment tools and impairment-focused treatment, communication beyond the impairment, such as the activity and participation domains, is also frequently assessed and treated.

What this paper adds to existing knowledge

- The majority of SLTs are dissatisfied with the overall benefits of current acquired dysarthria treatment. Phonatory, respiration and speech rate therapies are perceived to be more effective than prosody, articulation and resonance treatments. Despite a general lack of theoretical knowledge, most SLTs are interested in neuromuscular electrical stimulation treatment for acquired dysarthria.

What are the potential or actual clinical implications of this work?

- New, evidence-based treatments are needed for SLTs to be confident in the effectiveness of their acquired dysarthria treatment.

INTRODUCTION

There is 'both scientific and clinical evidence that suggests that individuals with dysarthria benefit from the services of speech-language pathologists' (Yorkston, 1996, p. S46). However, Duffy (1995, p. 386) argues that 'we do not know nearly as much about the effectiveness of [dysarthria] treatment as we should'. Despite the extensive progress made in the last decades in researching and treating diverse speech and language disorders, evidence-based management practices for dysarthria are still limited (Mitchell et al., 2017).

Surveys of speech and language therapists' (SLTs) management practices for acquired dysarthria conducted in the United Kingdom, the Republic of Ireland, Lebanon and Australia provide insights into the approaches taken by therapists to assess and treat acquired dysarthria (Collis & Bloch, 2012; Conway & Walshe, 2015: Gracia et al., 2020; Miller & Bloch, 2017; Rumbach et al., 2019; Summaka et al., 2021). Primarily, these studies indicate that informal assessments are the most frequently employed testing method in acquired dysarthria, followed by formal tests and lastly by instrumental measures. Clinical assessments are mainly impairment-focused; however, communication beyond the impairment, including activity (speech intelligibility tasks) and participation (speech comprehensibility during natural discourse) is also frequently assessed (Collis & Bloch, 2012; Dykstra et al., 2007; Miller & Bloch, 2017; Rumbach et al., 2019). This assessment approach aligns with the World Health Organization's International Classification of Functioning, Disability and Health (ICF, 2001) framework, underscoring the clinical relevance of assessing the interplay between physiological deficits and their impact on daily functioning and participation. While these findings offer valuable insights into the practices of SLTs, extrapolating these 'localised' research findings to a global perspective is necessary to obtain a wider perspective of SLT practices for the condition and increase the robustness and utility of research.

Regarding treatment, systematic reviews on dysarthria highlight the paucity of research and the limited evidence for the effectiveness of behavioural treatment (Mitchell et al., 2017; Morgan & Vogel, 2008). This lack of studies also extends beyond the 'typical', traditional management for dysarthria. A recent systematic review by Balzan et al. (2022) evidenced that dysarthria research involving novel treatment methods, such as non-invasive cortical (e.g., transcranial magnetic stimulation) and peripheral stimulation (e.g., neuromuscular electrical stimulation [NMES]), has received far less attention when compared to other impairments arising from neurological disease. Whilst only 10 studies investigated non-invasive brain stimulation in dysarthria, over 35 studies have been carried out within the field of aphasia using the same treatment methods (Balzan et al., 2022; Coslett, 2016). Similarly, whilst the use of NMES in dysarthria has to date not been investigated using experimental study designs, Alamer et al. (2020) identified 11 randomised controlled trials measuring NMES effectiveness in post-stroke dysphagia.

There is preliminary evidence to suggest NMES may be beneficial for treating acquired dysarthria. A pilot study by Kroker et al. (2018) found that 20 sessions of NMES, coupled with behavioural exercises (Dys-SAAR-thrietherapie), lasting 30 min each, led to improved articulation and intelligibility when speaking with unfamiliar listeners on the telephone in seven out of eight individuals with chronic post-stroke dysarthria. Similarly, two separate single case studies, one involving stroke and the other involving brain injury, reported reduced dysarthria severity and improved impairment-based outcomes following NMES treatment (Berenati et al., 2021; Tache-Codreanu & Cucu, 2020). The results of these studies should be interpreted with caution due to the heterogeneity of the methods used and the limited sample sizes.

Notwithstanding the controversy as to whether non-speech oral motor therapy approaches may benefit individuals with dysarthria, it has been argued that non-speech and speech movements lie along a continuum as both tasks share neural pathways and motor control mechanisms (Ballard et al., 2003; Chang et al., 2009). There is also significant overlap between the somatotopic organisation, anatomy and physiological processes of speech and swallowing mechanisms (Takai et al., 2010; Trupe et al., 2018). These arguments support several theories of orofacial control proposing that speech execution consists of motor productions or task dynamics and can hence be studied within a general motor control perspective, rather than focusing on the 'distinctiveness' of linguistically driven processes (Smith, 1992).

These presuppositions, along with the promising positive results from studies comparing combined NMES and traditional swallowing exercises in dysphagia to stand-alone swallowing manoeuvres (e.g., Byeon, 2020; Park et al., 2012), and the anecdotal use and preliminary evidence for NMES in dysarthria, provide a basis for further investigations into the use of NMES for the latter disorder. Determining stakeholders' interest and their likelihood of trying novel interventions is critical. This will help determine whether the undertaking of exploratory research on its use in acquired dysarthria is relevant and beneficial to patients and informative for clinicians (Riemer et al., 2012).

The limited pool of research on dysarthria treatment, which mostly dates to the late 20th century, and the dearth of supportive evidence for one dysarthria treatment approach over another are contributing factors to the inconsistent and varied treatment techniques employed by SLTs (Conway & Walshe, 2015; Mackenzie et al., 2010). The lack of consensus on appropriate treatment direction, which is further complicated by the delivery of different care pathways for non-progressive and progressive dysarthria cases, may compromise management practices, potentially resulting in the use of interventions that are not clinically understood or well-documented (Conway & Walshe, 2015; Mackenzie et al., 2010).

A key factor that influences the clinical treatment of health conditions is the perceived effectiveness of treatment. Research indicates that health professionals' perceptions of treatment benefit at improving patient outcomes is a significant determinant of treatment preferences, decision-making and suboptimal implementation (Covey, 2007; Vogt et al., 2009). When a large pool of research is available, then clinical treatment should be guided predominantly by explicit knowledge, the evidence base and patient values (Titler, 2008). However, in cases of limited evidence, treatment decisions are built predominantly on tacit knowledge, such as clinical experiences and expert opinions (Titler, 2008; Sandars, 2016). Given the dearth of evidence for acquired dysarthria treatment and the influential contribution of tacit knowledge in treatment decisions, research that evaluates SLTs perceptions of therapy effectiveness and interest in new therapy options can provide new insights on intervention planning and delivery.

The aims of this international study were: (1) to investigate SLTs' management practices for acquired dysarthria; (2) to gauge SLTs' perceptions of the effectiveness of speech subsystem treatments for the condition; (3) to determine SLTs' interest in using NMES as a treatment modality for dysarthria; (4) to assess whether SLTs in the field possess fundamental knowledge of NMES mechanisms; and (5) to determine whether SLTs' management practices, perceived effectiveness of treatment and interest in NMES as a potential acquired dysarthria treatment are influenced by demographic variables.

METHOD

An online quantitative cross-sectional survey was carried out as it allowed for recruitment of international participants with common demographic details in a short time interval (Taylor, 2000). A web-based survey was designed based on the recommendations proposed by Hlatshwako et al. (2021) for implementing online surveys and the five stages of survey design and testing (conceptualisation, design, testing, revision and data collection; Brancato et al., 2006).

Survey development

A conceptual framework with incorporated domains and indicators was initially created (Figure 1). This framework was based on items from previous research evaluating acquired dysarthria management practices (Conway & Walshe, 2015; Miller & Bloch, 2017) and on new domains and indicators relating to perceived treatment effectiveness, and interest in and knowledge of NMES treatment for dysarthria. The domains of the survey are illustrated in the vertical boxes and the empirical indicators for each domain are included horizontally in bullet format. The overlapping domains represent a conceptual overlap between the content of the domains.

The first version of the survey was then developed and appraised for face and content validity by the research team. Based on this appraisal, a second version consisting of six sections and a total of 35 items (31 close-ended and four open-ended items consisting of multiple, symmetric Likert matrices and ranked choices) was developed. Open-ended questions consisting of expansion questions were included to allow respondents to elaborate further on the choices given to a close-ended question. Piloting of the survey was carried out through one-to-one cognitive debriefings with 10 SLTs working with adults with acquired dysarthria in three different countries (Malta, United Kingdom and United States) using a convenience sampling method. The four-stage cognitive model (comprehension, retrieval, judgement, evaluation and response selection) proposed by Tourangeau (1984) was implemented to ensure that participants could understand, interpret and answer questions as intended.

Based on this piloting, the third version of the survey was developed: three questions were reworded, five questions were completely removed, the answering method for the two ranking questions was changed from drag and drop to a number ranking approach, and repeat headers were included in one Likert matrix. The third version of the survey was revised and another three SLTs were recruited to test this version. Apart from some minor language changes, no other changes were required. The fourth and final version of the survey was then published on Qualtrics^{XM} (www.qualtrics.com).

The final survey was divided into six sections, covering the following topics: (1) participant information and consent; (2) demographics; (3) dysarthria assessment; (4) dysarthria treatment and perceived effectiveness; (5) interest in NMES as a treatment modality; and (6) knowledge of NMES mechanisms (the full survey is available in Supplementary Material). Figure 2 provides an overview of the information that was sought for each of these sections.

Inclusion criteria

Inclusion criteria for participation were: (1) hold a speech-language therapy qualification from a licensed international speech-language body; (2) assess and treat individuals with acquired dysarthria as part of the clinical caseload; and (3) possess proficient English language skills for survey completion.

Data collection

Ethical approval was sought from the University Research Ethics Committee of the University of Sheffield (Reference number 036240). A convenience sampling strategy was employed for the recruitment of participants. SLTs were recruited through international speech-language therapy associations. Associations that agreed to participate in the research distributed the study details to their members via (1) online posts on their social media profiles; (2) posts on their websites; (3) e-mails using a members distribution list; and (4) newsletters.

Data analysis

In contrast to other online survey platforms, Qualtrics captures both completed and submitted responses, as well as in-progress responses that have been started and partially filled but not submitted. In this study, in-progress responses were excluded from the data analysis, and only the submitted responses were analysed.

Data were examined using the Statistical Package for the Social Sciences (IBM SPSS Version 27, 2020). Descriptive

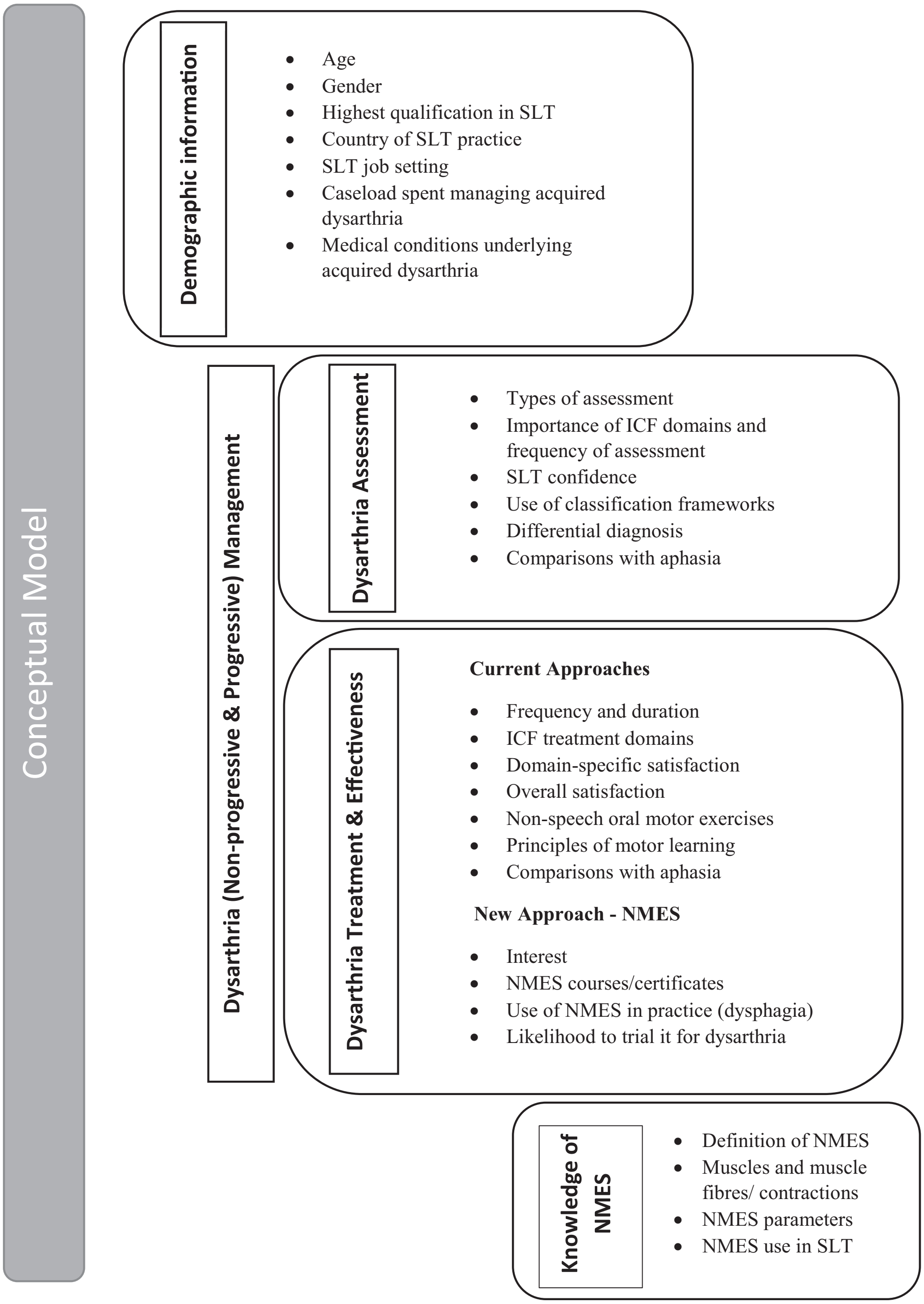
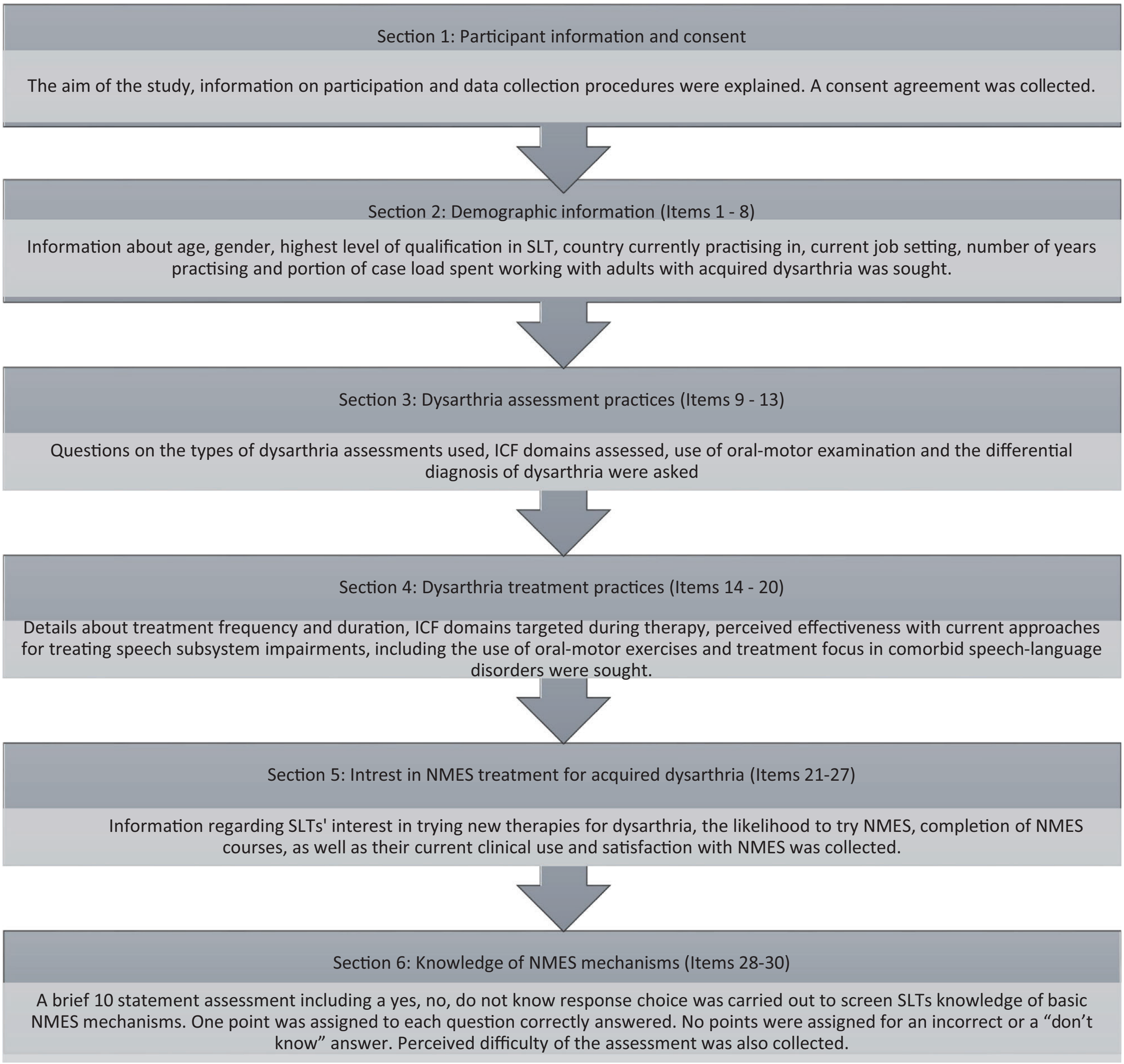


FIGURE 1 Conceptual framework: Domains and indicators. Abbreviations: ICF, International Classification of Functioning, Disability and Health; NMES, neuromuscular electrical stimulation; SLT, speech-language therapist.

and inferential statistics were used to summarise the data. Since most survey items involved ordinal type of data (Sullivan & Artino, 2013), non-parametric statistical tests were primarily used. Weighing of items to adjust for missing data was not necessary as none of the submitted responses were incomplete.

The Kruskal–Wallis test was used to compare ratings relating to therapy duration and frequency and use of trialling NMES for dysarthria across demographic variables. Pairwise comparisons were performed using Dunn's procedure with a Bonferroni correction for multiple comparisons. An independent-samples *t* test and a Mann–Whitney U test were carried out to determine if there were differences in the knowledge test score and perceived test difficulty respectively among respondents who were trained or certified in NMES (e.g., VitalStim® Therapy Certification and Ampcare ESP™ certification) and those who had not obtained training in the use of NMES



Section 1: Participant information and consent

The aim of the study, information on participation and data collection procedures were explained. A consent agreement was collected.

Section 2: Demographic information (Items 1 - 8)

Information about age, gender, highest level of qualification in SLT, country currently practising in, current job setting, number of years practising and portion of case load spent working with adults with acquired dysarthria was sought.

Section 3: Dysarthria assessment practices (Items 9 - 13)

Questions on the types of dysarthria assessments used, ICF domains assessed, use of oral-motor examination and the differential diagnosis of dysarthria were asked

Section 4: Dysarthria treatment practices (Items 14 - 20)

Details about treatment frequency and duration, ICF domains targeted during therapy, perceived effectiveness with current approaches for treating speech subsystem impairments, including the use of oral-motor exercises and treatment focus in comorbid speech-language disorders were sought.

Section 5: Intrest in NMES treatment for acquired dysarthria (Items 21-27)

Information regarding SLTs' interest in trying new therapies for dysarthria, the likelihood to try NMES, completion of NMES courses, as well as their current clinical use and satisfaction with NMES was collected.

Section 6: Knowledge of NMES mechanisms (Items 28-30)

A brief 10 statement assessment including a yes, no, do not know response choice was carried out to screen SLTs knowledge of basic NMES mechanisms. One point was assigned to each question correctly answered. No points were assigned for an incorrect or a “don't know” answer. Perceived difficulty of the assessment was also collected.

FIGURE 2 Description and flow of the survey sections. Abbreviations: ICF, International Classification of Functioning, Disability and Health; NMES, neuromuscular electrical stimulation; SLT, speech-language therapist. [Colour figure can be viewed at wileyonlinelibrary.com]

technology. A multinomial logistic regression was carried out to predict the overall rating of the satisfaction with therapy effectiveness given by respondents based on age group, gender, continent and years practising.

For the open-ended question asking SLTs to state the reasons for the rating given to the overall effectiveness of acquired dysarthria therapy, a quantitative content analysis was carried out in accordance with the methods proposed by O'Cathain and Thomas (2004). An inductive coding frame was devised and was manually applied to all answers. The codes were then entered into SPSS and treated as a variable for quantitative analysis. The distribution and percentages of emerging categories were then computed for the overall satisfaction ratings (strongly dissatisfied to strongly satisfied) assigned by respondents.

RESULTS

Demographics of SLTs

The online survey was accessed by a total of 326 participants. Out of these, 115 participants started the survey but did not finish it. The remaining 211 participants completed the survey in full, a completion rate of 64.7%. The response rate could not be estimated as the sampling methods employed made it difficult to determine the total number of eligible SLTs who received and accessed the survey. Nevertheless, a sample of 211 participants selected from a large population of SLTs worldwide guaranteed a 6.75% margin of error assuming a 95% confidence level.

Table 1 provides a summary of the demographic characteristics of respondents. Most respondents were female (91%, $n = 192$) and the most common level of qualification was a master's degree (66.8%, $n = 141$). The majority of SLTs were practising in North America, (48.8%, $n = 103$) and Europe (36%, $n = 76$). The remainder were practising in Asia (8.1%, $n = 17$), Oceania (5.7%, $n = 12$), Africa (0.9%, $n = 2$) and South America (0.5%, $n = 1$) (see Table SA1 for the distribution of participants by country of practice). The largest portion of respondents had 6–10 years (25.6%, $n = 54$) or 11–20 years (27%, $n = 57$) clinical experience. For more than one-third of participants (41.2%, $n = 87$), acquired dysarthria comprised 10%–25% of their caseload with the most common work settings being acute (36.5%, $n = 77$), rehabilitation (27%, $n = 57$) and outpatient or day hospitals (27%, $n = 57$). The most frequent medical aetiologies giving rise to acquired dysarthria on respondents' caseloads were stroke (94.3%, $n = 199$), Parkinson's disease (73%, $n = 154$) and brain injury (63%, $n = 133$).[1]

Assessment practices for acquired dysarthria

Evaluations of acquired dysarthria primarily consisted of informal perceptual assessment measures (86.7%, $n = 183$). Approximately 90% of respondents answered that they '*always*' or '*frequently*' complete an oral-motor examination during assessment (Table SA2). More than half of respondents also administered formal perceptual assessments, such as the Frenchay Dysarthria Assessment-2 (Enderby & Palmer, 2008) and the Assessment of Intelligibility of Dysarthric Speech (Yorkston & Beukelman, 1981b) (56.4%, $n = 113$). In contrast, instrumental assessments (e.g., measurement of acoustic parameters, such as fundamental frequency, loudness and jitter) were carried out by only approximately a quarter of respondents (27%, $n = 57$).

The most frequently assessed ICF domains were body functions and structures (*always,* 77.7%, $n = 164$; *frequently*; 18.5%; $n = 39$) and personal factors (*always,* 45.5%, $n = 96$; *frequently*; 35.5%, $n = 75$) (Figure 3). Although the remaining ICF domains (activities, participation and environmental factors) were less frequently assessed, approximately two-thirds of participants still reported that they *always* or *frequently* assess them.

In terms of ICF domain importance, from 1 being the most important to 5 being the least important, assessment of body functions and structures (mean rank: 1.55) followed by activities (mean rank: 2.75) were ranked as the most important domains in acquired dysarthria assessment (Table SA3). A lower mean score was given to participation (mean rank: 3.29), personal factors (mean rank: 3.47) and environmental (mean rank: 3.93).

A Kruskal–Wallis test did not show any significant differences in the ranking of ICF domains across therapists' practising continent (body functions and structures, $p = 0.09$; activities, $p = 0.07$; participation, $p = 0.92$; environmental factors, $p = 0.05$; personal factors, $p = 0.05$). Regarding clinical settings, significant differences were evidenced only for the activities domain ($p = 0.01$) (Table SA4). Long-term care facilities, private practice and mental health hospitals assigned a lower importance rank to the activities domain when compared to acute, rehabilitation and outpatient or day hospitals and community or university clinics. No significant differences were observed for the body functions and structures ($p = 0.88$), participation ($p = 0.33$), environmental factors ($p = 0.12$) and personal factors domains ($p = 0.64$).

More than two-thirds of respondents reported that they feel confident in their abilities to assess acquired dysarthria (Table 2). Conversely, less than half of respondents feel confident in reaching a differential diagnosis of dysarthria and its subtypes. Assessment frameworks, such as that proposed by Darley, Aronson and Brown, were only used by 40% of respondents (agree, 31.8%, $n = 67$; strongly agree, 11.8%, $n = 25$). Approximately one-third of participants agreed that they find dysarthria assessments to be more challenging than aphasia assessments (agree, 27%, $n = 57$; strongly agree, 6.6%, $n = 14$) and that differential diagnosis of dysarthria and its subtypes is more complex than in aphasia (agree, 33.6%, $n = 71$; strongly agree, 8.5%, $n = 18$).

Treatment practices and perceived effectiveness

Table 3 summarises respondents' therapy frequency and duration patterns for acquired dysarthria. The most common treatment frequencies were reported to be *about two to three times a week* (38.9%, $n = 82$,) and *once a week* (25.6%, $n = 54$,). The least commonly chosen treatment frequencies were *less than once a month* (4.3%, $n = 9$) and *once a month* (3.3%, $n = 7$). Concerning therapy duration, the most common duration was of *11 to 20 sessions* (28.4%, $n = 60$), followed by *6–10 sessions* (23.2%, $n = 49$).

For therapy duration, differences across practising continent ($p = 0.43$) and clinical setting ($p = 0.11$) were not statistically significant. However, significant differences were observed for therapy frequency across continents

TABLE 1 Participant demographic details.

Participant characteristics		n	%
Gender	Male	18	8.5
	Female	192	91.0
	Prefer not to say	1	0.5
Age	18–25 years	11	5.2
	26–35 years	98	46.4
	36–45 years	46	21.8
	46–55 years	32	15.2
	56–65 years	22	10.4
	Older than 65 years	2	0.9
Continent of SLT practice	Europe	76	36.0
	North America	103	48.8
	South America	1	0.5
	Asia	17	8.1
	Oceania	12	5.7
	Africa	2	0.9
Highest qualification	Diploma	1	.5
	Undergraduate degree	48	22.7
	Postgraduate diploma	7	3.3
	Master's degree	141	66.8
	Doctorate degree	14	6.6
Years of SLT practice	1–2 years	25	11.8
	3–5 years	36	17.1
	6–10 years	54	25.6
	11–20 years	57	27.0
	21–30 years	23	10.9
	More than 30 years	16	7.6
Current clinical settings[a]	Acute hospital	77	36.5
	Rehabilitation hospital	57	27.0
	Outpatient or day hospital	57	27.0
	Mental health hospital	2	0.9
	Long-term care facilities	25	11.8
	Community-based therapy	38	18.0
	Private practice	37	17.5
	University clinic	22	10.4
	Others	11	5.2
Percentage of caseload with acquired dysarthria	Less than 10%	50	23.7
	10% to 25%	87	41.2
	26% to 50%	51	24.2
	51% to 75%	18	8.5
	More than 75%	5	2.4
Medical aetiologies underlying acquired dysarthria encountered in clinical setting[a]	Motor neuron disease	54	25.6
	Stroke	199	94.3
	Parkinson's disease	154	73.0
	Huntington's disease	9	4.3
	Brain injury	133	63.0
	Brain tumour	40	19.0
	Muscular dystrophy	5	2.4

(Continues)

TABLE 1 (Continued)

Participant characteristics		n	%
	Multiple sclerosis	26	12.3
	Drug induced	4	1.9
	Progressive supranuclear palsy	7	3.3
	Multiple system atrophy	4	1.9

a More than one choice could be selected.
Abbreviation: SLT, speech-language therapist.

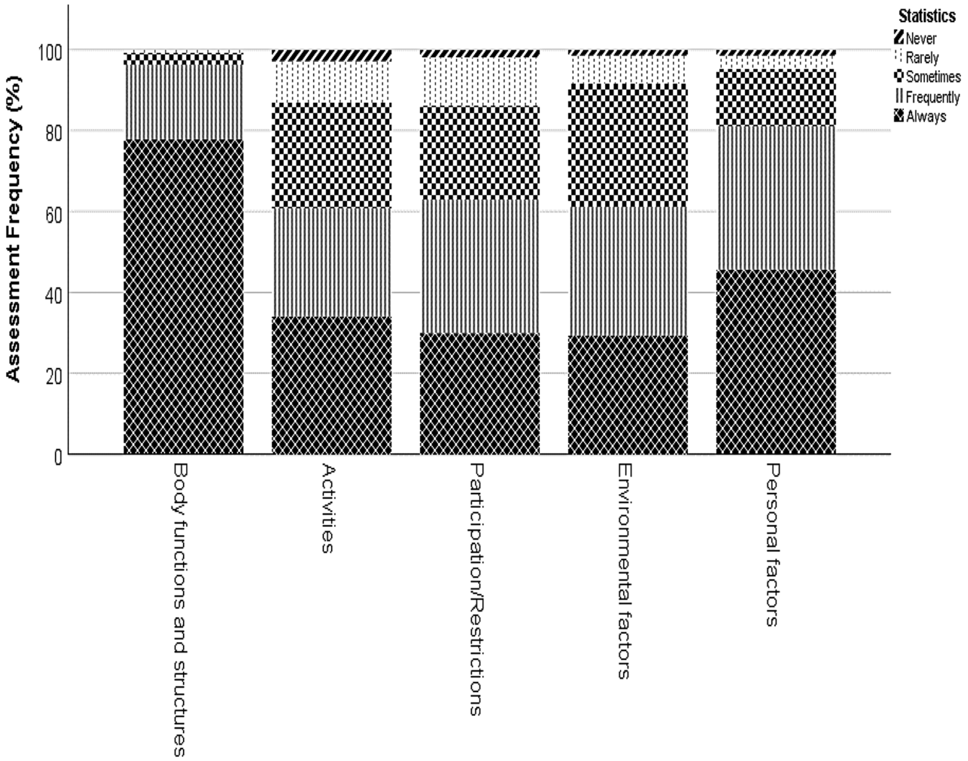


FIGURE 3 ICF domains assessment frequency (%) in acquired dysarthria assessment. Abbreviation: ICF, International Classification of Functioning, Disability and Health.

($p < 0.001$) and clinical settings ($p < 0.001$) (Tables SA5 and SA6). Post hoc analysis revealed statistically significant differences in therapy frequency between therapists practising in Europe and North America ($p < 0.001$), but not between any other group combination (Table SA7). Whilst the mean therapy frequency in Europe was once a week, the mean frequency in North America was about two to three times per week. Regarding therapy frequency across clinical settings, the post hoc analysis revealed that therapy frequency was significantly higher for rehabilitation hospitals when compared to private practice ($p = 0.04$) and community-based therapy ($p < 0.001$) respectively (see Table SA8). No other significant differences in therapy frequency were evidenced between any other settings.

The most important ICF domains in treatment, ranked from 1 (most important) to 5 (least important) by respondents, were reported to be *body functions and structures* (mean = 1.73) and *activities* (mean = 2.67). *Participation* (mean = 3.38), *environmental* (mean = 3.60) and *personal factors* (mean = 3.60) were ranked as the least important ICF domains in treatment (Table SA9).

At a speech subsystem level, the majority of respondents were *strongly satisfied* or *satisfied* with current treatment approaches to treat phonation, respiration and speech rate impairments associated with acquired dysarthria (Table 4). On the contrary, less than half of respondents were *strongly satisfied* or *satisfied* with the therapy options currently available to treat impairments in articulation, resonance and prosody. More than a third of respondents reported that they have never treated resonance in dysarthria.

TABLE 2 Attitudes towards aspects of acquired dysarthria assessment.

Statement	Strongly disagree		Disagree		Neither agree nor disagree		Agree		Strongly agree	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
I am confident in my abilities to assess individuals with dysarthria	7	3.3%	33	15.6%	30	14.2%	89	42.2%	52	24.6%
I am confident in my ability to identify and describe the sub-types of dysarthria	12	5.7%	45	21.3%	49	23.2%	77	36.5%	28	13.3%
I use classifications such as the Mayo Clinic Classification System to identify the sub-type of dysarthria	36	17.1%	50	23.7%	33	15.6%	67	31.8%	25	11.8%
I find dysarthria assessments to be more challenging than aphasia assessments	22	10.4%	64	30.3%	54	25.6%	57	27.0%	14	6.6%
Differential diagnosis of dysarthria and its sub-types is more complex than the diagnosis of aphasia and its sub-types	16	7.6%	52	24.6%	54	25.6%	71	33.6%	18	8.5%

TABLE 3 Distribution of acquired dysarthria therapy frequency and duration.

Therapy characteristics		*n*	%
Frequency	Every day (five times a week)	38	18.00%
	About two to three times a week	82	38.90%
	About once a week	54	25.60%
	About once every 2 weeks	21	10.00%
	Once a month	7	3.30%
	Less than once a month	9	4.30%
Duration	1–2 sessions	5	2.4%
	3–5 sessions	35	16.6%
	6-10 sessions	49	23.2%
	11–20 sessions	60	28.4%
	21–30 sessions	19	9.0%
	More than 30 sessions	16	7.6%
	Others	27	12.8%

The overall positive satisfaction with current treatment options for acquired dysarthria was approximately 40% (*strongly satisfied*, 2.4%, $n = 5$, *satisfied*, 37.9%, $n = 80$). The remaining respondents mainly reported that they are *dissatisfied* (34.1%, $n = 72$) *neither dissatisfied nor satisfied* (23.7%, $n = 50$) or *strongly dissatisfied* (1.9%, $n = 4$). Results of a multinomial logistic regression indicate that practising continent had a statistically significant effect on the overall satisfaction rating given by respondents ($p < 0.001$) (Table SA10). Age group, gender and years of practice were not found to be significant factors in the overall satisfaction rating attributed to current treatment options.

A quantitative content analysis was carried out to identify categories that influenced respondents' ratings of the overall effectiveness of treatment. The categories that emerged and their respective frequencies, clustered according to the overall rating (from strongly dissatisfied to strongly satisfied), are illustrated in Figure 4. Participants who gave a negative satisfaction rating were most dissatisfied with impairment-based, post-treatment improvements and the limited evidence base for dysarthria treatment. Amongst the positive ratings, the most frequent categories were clinician-reported improvements following treatment and effectiveness of therapy programmes for specific dysarthria subtypes or speech subsystems (e.g., Lee Silverman Voice Training [LSVT], Speak Out and Expiratory Muscle Strength Training [EMST]). Examples with quotes for each of the categories that emerged are presented in Table SA11.

More than half of respondents disagreed with the statements that non-speech oral motor exercises (NSOMEs) are routinely used in their clinic (*strongly disagree,* $n = 75$, 35.5%; *disagree,* $n = 57$, 27.0%), or given as advice to clients to treat acquired dysarthria (*strongly disagree,*

TABLE 4 Speech subsystem and overall satisfaction rating with current treatment for acquired dysarthria.

Speech subsystem		Strongly dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Strongly satisfied	Have not treated this impairment
Phonation	*n*	1	18	28	91	65	8
	%	0.5%	8.5%	13.3%	43.1%	30.8%	3.8%
Respiration	*n*	5	20	31	99	46	10
	%	2.4%	9.5%	14.7%	46.9%	21.8%	4.7%
Articulation	*n*	7	52	46	77	25	4
	%	3.3%	24.6%	21.8%	36.5%	11.8%	1.9%
Resonance	*n*	6	46	45	27	5	82
	%	2.8%	21.8%	21.3%	12.8%	2.4%	38.9%
Prosody	*n*	3	66	44	58	23	17
	%	1.4%	31.3%	20.9%	27.5%	10.9%	8.1%
Speech rate	*n*	2	24	36	108	32	9
	%	0.9%	11.4%	17.1%	51.2%	15.2%	4.3%
Overall	*n*	4	72	50	80	5	
	%	1.9%	34.1%	23.7%	37.9%	2.4%	

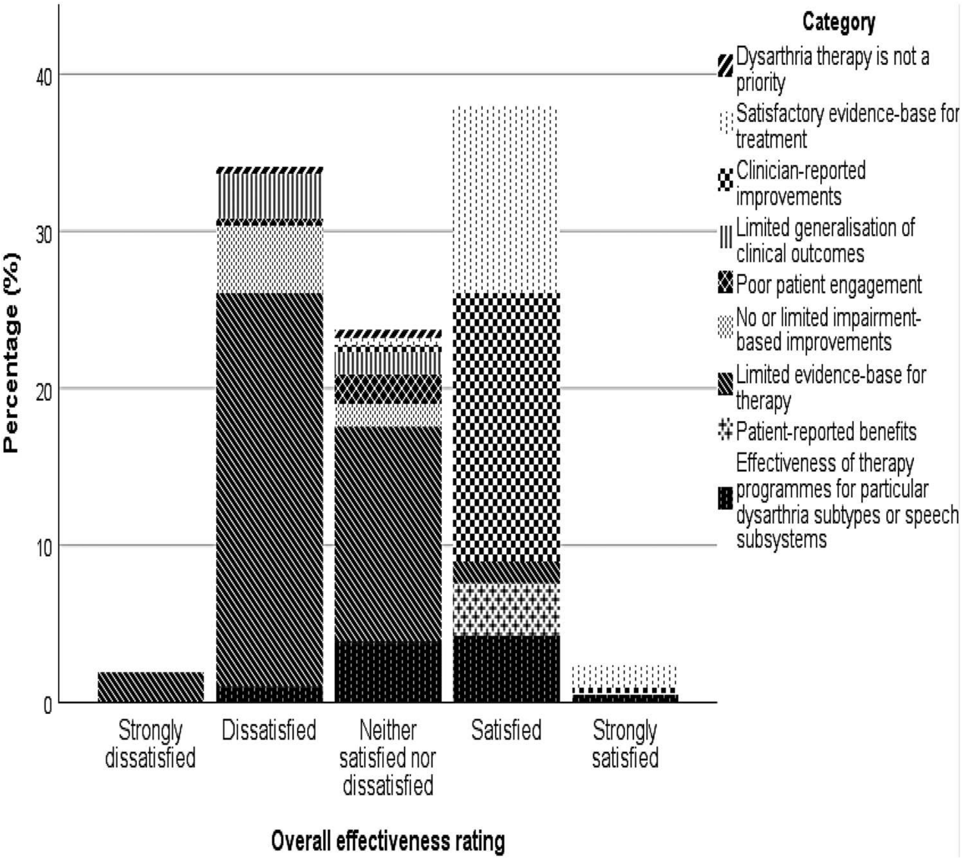


FIGURE 4 Quantitative content analysis (frequency of categories) of the reasons for the overall satisfaction with the effectiveness of acquired dysarthria therapy.

TABLE 5 Attitudes towards aspects of acquired dysarthria treatment.

Statement %	n	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I routinely make use of non-speech oral motor exercises to treat acquired dysarthria	n	75	57	28	40	11
	%	35.5%	27.0%	13.3%	19.0%	5.2%
I routinely advise clients to complete non-speech oral motor exercises at home	n	78	52	24	42	15
	%	37.0%	24.6%	11.4%	19.9%	7.1%
Non-speech oral motor exercises need to be repeated several times in order to improve speech in dysarthria	n	64	38	32	53	24
	%	30.3%	18.0%	15.2%	25.1%	11.4%
I routinely make use of principles of motor learning and neuroplasticity during therapy	n	5	12	40	112	42
	%	2.4%	5.7%	19.0%	53.1%	19.9%
If an individual has an aphasia and a dysarthria, I usually focus on the aphasia during treatment	n	4	30	73	84	20
	%	1.9%	14.2%	34.6%	39.8%	9.5%
Despite receiving speech-language therapy, most individuals with dysarthria remain with life-changing speech deficits	n	5	53	46	92	15
	%	2.4%	25.1%	21.8%	43.6%	7.1%
There is lack of scientific evidence for effective interventions in dysarthria	n	8	45	52	82	24
	%	3.8%	21.3%	24.6%	38.9%	11.4%
Future research about novel treatment approaches in dysarthria are not necessary	n	102	88	8	8	5
	%	48.3%	41.7%	3.8%	3.8%	2.4%

$n = 78$, 37.0%; *disagree,* $n = 52$, 24.6%) (Table 5). Approximately half of the participants also disagreed that repetition of NSOMEs will improve speech functions (*strongly disagree,* $n = 64$, 30.3%; *disagree,* $n = 38$, 18%). Approximately two-thirds of respondents agreed that they employ principles of motor learning during acquired dysarthria treatment (*agree,* $n = 112$, 53.1%; *strongly agree,* $n = 42$, 19.9%). Half of the respondents also agreed that most individuals with dysarthria remain with life-changing speech impairments despite attending speech-language therapy (*agree,* $n = 92$, 43.6%; *strongly agree,* $n = 15$, 7.1%). Half of the respondents also reported that if an individual has an aphasia and a dysarthria, they are likely to focus on the aphasia during therapy (*agree,* $n = 84$, 39.8%; *strongly agree,* $n = 20$, 9.5%).

Interest in and knowledge of NMES mechanisms

More than three-fourths of respondents ($n = 65$, 78.2%) reported that they would be interested in testing new treatments for acquired dysarthria (Table SA12). Only one-fourth ($n = 59$, 28%) of respondents reported that they have completed NMES training (Table SA13). Out of these, more than three-fourths of participants completed VitalStim training ($n = 45$, 76.3%). The remaining participants completed Ampcare ESP ($n = 10$, 17.0%), eSwallow ($n = 2$, 3.39%) and Guardian ($n = 2$, 3.39%) training. More than half of respondents trained in NMES reported that they use it clinically to treat dysphagia ($n = 34$, 57.6%). Amongst this group, the satisfaction rating for the perceived effectiveness of NMES was approximately 70% (*satisfied*, $n = 21$, 61.8%, *strongly satisfied*, $n = 2$, 5.9%) (Table SA14). Despite the lack of clinical guidance for the use of NMES in dysarthria, five respondents indicated that they have used this modality to treat the speech disorder.

When specifically asked to rate their likelihood to trial a new treatment for acquired dysarthria if it involves characteristic and procedural features of NMES, more than half of respondents reported that they are *likely* or *very likely* to use a medical device that delivers electrical signals to muscles (*likely*, $n = 76$, 36%; *very likely*, $n = 34$, 16.1%), to place electrode pads on the neck and face area muscles (*likely*, $n = 88$, 41.7%; *very likely*, $n = 35$, 16.6%), to obtain training for the use of the device (*likely*, $n = 94$, 44.5%; *very likely*, $n = 42$, 19.9%) and to deliver an intensive schedule of treatment (*likely*, $n = 72$, 34.1%; *very likely*, $n = 31$, 14.7%) (Table 6). However, less than half of respondents are likely to deliver the treatment if it involves minor discomfort, redness of the skin or a tingling sensation (*likely*, $n = 72$, 34.1%; *very likely*, $n = 15$, 7.1%).

For most statements, the Kruskal–Wallis test did not evidence any significant differences in attitudes towards trialling in NMES for acquired dysarthria across demographic variables. Significant differences were evidenced only for the intensive schedule of treatment statement across job settings ($p = 0.007$) and for completing training

TABLE 6 Attitudes towards trialling neuromuscular electrical stimulation (NMES) for acquired dysarthria.

Statement %	*n* %	Very unlikely	Unlikely	Neither likely nor unlikely	Likely	Very likely
The use of a medical device that delivers low electrical impulses to stimulate patient's muscles	*n*	14	32	55	76	34
	%	6.6%	15.2%	26.1%	36.0%	16.1%
The placement of small sticky electrode pads on the patient's face and neck areas	*n*	11	24	53	88	35
	%	5.2%	11.4%	25.1%	41.7%	16.6%
Patient may experience minor discomfort, redness of the skin or tingling sensation	*n*	15	41	68	72	15
	%	7.1%	19.4%	32.2%	34.1%	7.1%
An intensive schedule of treatment consisting of 20 therapy sessions of 30 min, spread out over a period of at least 4 weeks	*n*	22	43	43	72	31
	%	10.4%	20.4%	20.4%	34.1%	14.7%
Completing training and obtaining accreditation for the use of a medical device	*n*	7	21	47	94	42
	%	3.3%	10.0%	22.3%	44.5%	19.9%

and obtaining accreditation across the practising continent ($p = 0.008$) and qualification level variables ($p = 0.005$) (Tables SA15–SA19). Acute hospitals, community-based therapy and other settings were less likely to implement an intensive NMES treatment when compared to clinical settings such as private clinics, university clinics and rehabilitation hospitals.

Regarding knowledge of NMES physiology and mechanisms, the mean score of respondents on the 10-question knowledge test was 4.12 out of 10 ($SD = 1.674$). On a scale from 1 to 10, with 1 being very easy to 10 being very difficult, the mean perceived difficulty of the test was 6.74 ($SD = 2.05$). The knowledge test score was significantly higher in NMES certified (5.27 ± 1.59) than non-certified (3.68 ± 1.49) respondents ($p < 0.0005$). Similarly, a statistically significant difference in perceived test difficulty was evidenced between NMES certified (5.49 ± 2.16) and non-certified respondents (7.22 ± 1.79) ($p < 0.0005$), with non-certified participants perceiving the knowledge test as more difficult than NMES-certified respondents.

DISCUSSION

To the best of our knowledge, the current research is the first international study to explore and compare SLTs' management practices for acquired dysarthria. The perceived effectiveness of current treatments and interest in and knowledge of NMES were also gauged, with the aim that future research focusing on improving patient outcomes for acquired dysarthria is acceptable and grounded in 'useful' knowledge (explicit and tacit knowledge) (Sandars, 2016) that is important to SLTs' decision-making.

Assessment practices

Even though several formal dysarthria assessments are commercially available, this study found that practising SLTs are more likely to use informal than formal tools to assess the condition. Expectedly, minimal use of instrumental assessment methods (acoustic analyses [e.g., fundamental frequency and loudness], kinematic [e.g., electromagnetic articulography] and aerodynamic measures [e.g., phonation threshold pressure]) was reported. These results are in line with previous research indicating that informal assessments remain the most frequently employed assessment method for neurogenic dysarthria, with formal methods receiving less consideration and instrumental methods remaining relatively neglected (Collis & Bloch, 2012; Miller & Bloch, 2017).

Whilst Miller and Bloch (2017) argue that the reliance on informal measures could be related to high proportions of respondents working in acute and post-acute hospital settings where individuals with dysarthria may show spontaneous recovery of speech functions, this study suggests that reliance on informal measures could also be related to clinicians' confidence in their ability to assess neurogenic dysarthria without the need to rely on formal assessment tools. Whilst the reported high rate of confidence may indicate adequate competence, performance and action, it may also reflect a tendency towards overconfidence (Miller, 1990). On this issue, Berner and Graber (2008) suggest that overconfidence may arise from inadequate knowledge, discrepancy between one's own self-rated accuracy and their actual accuracy or limitations in heuristic problem-solving. Regarding oral motor examinations, despite their controversial clinical relevance in acquired dysarthria, this study has found that nearly all participants employ them during assessment. This is also in line with the findings reported in Collis and Bloch (2012) and Miller and Bloch (2017).

Informal assessments that mirror real-life communication activities have social validity and can expose features of the presenting speech and language impairment that are not captured easily by formal testing alone (Miller, 2013; Ramsberger & Rende, 2002). Nevertheless, the fact that several clinicians opt not to employ formal assessments at all may have some limitations. Issues with the identification and differential diagnosis of dysarthria, reliability and accuracy of findings, selection of outcome measures for rehabilitation and gauging improvement between pre and post-intervention are frequently reported (Miller & Bloch, 2017).

The infrequent use of formal dysarthria assessments may explain the following present study findings: (1) half of clinicians do not feel confident in reaching a differential diagnosis of dysarthria subtype and (2) there is a general disuse of classification systems, such as the Mayo Clinic system proposed by Darley et al. (1975). The lack of use of classification systems to assess dysarthria was also reported in the work by Conway and Walshe (2015). It transpires that despite the ability to identify core speech deficits indicative of dysarthria, SLTs find it difficult to reach a differential diagnosis of its subtype. This disparity could be related to the fact that there are a myriad of speech atypicalities that manifest simultaneously in more than one dysarthria subtype (this discussion has ensued for non-progressive dysarthrias, particularly related to stroke, but the usefulness of classification has not yet been reviewed for progressive conditions). As a result, arriving at a diagnosis of dysarthria subtype is often a complex task.

In keeping with the study by Collis and Bloch (2012), this study found that the most frequently assessed ICF domain remains the impairment level. Nonetheless, the majority of SLTs are also always, or frequently, assessing the activity, participation, personal and environmental domains. In terms of importance, the impairment and activity domains were the most valued, with participation, environmental and personal domains receiving a nearly equal importance value. Taken together, these findings suggest that even though the impairment and activities domain are the primary focus in acquired dysarthria assessment, there is an overall appreciation of the added value that all the domains in the ICF framework can bring to the clinical assessment table.

Treatment practices

The majority of individuals with acquired dysarthria are on average offered between one and three therapy sessions a week and are likely to receive between 6 and 20 sessions of treatment. The high frequency of therapy sessions reported in this study may be explained by the fact that the majority of surveyed SLTs were working in hospital settings, including acute care, rehabilitation, and outpatient hospital facilities. However, since the frequency of therapy sessions may be influenced by other factors, such as the nature and severity of the dysarthria, this finding should be interpreted with caution.

SLTs reported that the body functions and structures, and the activities domains were the most important domains to be targeted during therapy. As a result, clinical rehabilitation is likely to primarily target deficits of the speech production subsystems, such as reduced respiratory support, articulatory impairments, phonatory abnormalities and how these several atypicalities influence intelligibility in the context of daily communication functions. Key focus on the impairment and activity domains may partly reflect the prioritisation of therapy goals by individuals with dysarthria. For instance, specific to the non-progressive dysarthria population, Dickson et al. (2008) found that regardless of dysarthria severity, individuals yearn for the full recovery of their lost communication abilities. Indeed, half of the participants in their study, diagnosed clinically with mild and moderate dysarthria, hoped that dysarthria rehabilitation would not only give rise to speech improvements, but would allow them to return to 'speak perfectly normally' as they did prior to their stroke (p. 142).

The use of NSOMEs to treat neurogenic dysarthria both during therapy sessions and as a carryover task was reported by only approximately one-fourth of participants. This result contradicts previous research findings that suggested there was widespread use of stand-alone NSOMEs, or combined with speech drills, as a frequently employed treatment approach with this population (Conway & Walshe, 2015; Mackenzie et al., 2010). Additional research is necessary to determine whether the use of NSOMEs is influenced by dysarthria characteristics, such as differences between progressive and non-progressive dysarthria, as well as among subtypes. For instance, the use of NSOMEs may be more suitable for individuals with non-progressive flaccid dysarthria as weakness is the predominant deficit in this subtype (Duffy, 2019).

Regarding principles of motor learning, the routine use of these principles in dysarthria treatment was reported by two-thirds of respondents, a finding similar to that reported by Conway and Walshe (2015). Nevertheless, since the survey only broadly targeted principles of motor learning without delving into the details of using specific optimal conditions for learning, we are unable to confirm the accuracy of this finding. Taken together, these results may reflect an increased awareness and understanding of principles that drive experience-dependent neuroplasticity, such as that rehabilitation needs to be salient to be effective (e.g., Maas et al., 2008).

High levels of clinician satisfaction with treatment approaches targeting the phonatory, respiratory and speech rate impairments were observed. However, a considerably lower satisfaction rating was evidenced for therapy approaches aimed at treating articulatory, prosodic and resonatory impairments. Although the reasons for this disparity in satisfaction ratings across speech subsystems warrant further in-depth investigation, it is proposed that this could be related to differences in the pool of evidence currently available to treat specific subsystem impairments. Specifically, the available evidence base for therapy approaches targeting phonation, respiration and speech rate is noticeably broader than those available to treat resonance and prosody (Duffy, 2019; Yorkston et al., 2001, 2003, 2007). This proposition is further supported by the fact that in the relative absence of an evidence base for behavioural resonance treatment, more than one-third of clinicians opted to never treat this impairment. On this topic, recent research by Hawthorne and Fischer (2020) suggests that SLTs may not frequently assess and treat prosody because of limited understanding of its nature, inadequate knowledge of relevant management options and the lack of clinical experience with this population. Consequently, treatment planning and prioritisation of outcomes may be guided, and potentially jeopardised, by SLTs' 'preferred' approaches and lack of competency and performance, rather than being tailored to align with individuals' real treatment needs and preferences.

Less than half of respondents were satisfied with the overall effectiveness of current treatment approaches for acquired dysarthria. The quantitative content analysis evidenced that the poor satisfaction ratings can be mainly attributed to: (1) the lack of an evidence base for treatment and (2) the limited impairment-based improvements reported following clinical intervention. Another reason for the poor rating was that the effectiveness of therapy was seen as being solely limited to specific therapy programmes, such as the LSVT, Speak Out or EMST. The findings of the content analysis reflect the strong disagreement rating given by respondents on the statement that novel research investigating treatment approaches for dysarthria was not necessary. Based on these results, we corroborate that Duffy's (1995) argument about dysarthria treatment as an under-researched field is still relevant today.

Interest in and knowledge of NMES mechanisms and application

The study findings suggest that most SLTs, irrespective of demographic variables, were interested in trialling new treatments for neurogenic dysarthria. This positive interest extended to treatments involving NMES procedures, such as obtaining formal training for its use, applying electrodes to the face and neck area and administering intensive treatment. In addition, more than two-thirds of respondents who use NMES for dysphagia were satisfied with the benefits associated with this treatment modality. These findings, along with the encouraging results from studies of NMES treatment for dysphagia and dysarthria ground the completion of additional exploratory NMES trials with the field of dysarthria. Studies focusing on the feasibility, acceptability, safety and efficacy of using NMES to treat acquired dysarthria in clinical settings should be conducted in the first instance.

Despite the interest in NMES treatment for dysarthria, an overall lack of training and expertise in the field was evidenced. Indeed, only one-fourth of respondents were trained in the use of NMES for dysphagia. Moreover, the mean scores on the NMES knowledge test were considerably low across both NMES-trained and non-trained respondents, even though trained users exhibited a statistically significant higher performance. Despite the increased evidence-base for the use of NMES in dysphagia, the treatment modality is still not offered in public hospitals or clinics and insurance coverage is limited. In the absence of opportunities for NMES practice or use in the clinical setting, it is likely that trained respondents experienced knowledge and skill decay (Yang et al., 2012). Whilst the limited knowledge in the field should not discourage any future research endeavours that may bring forth positive evidence for NMES application to treat acquired dysarthria, learning opportunities comprising of initial and maintenance training phases and hands-on practice, would need to be offered to support clinicians' professional development and ensure the safe application of NMES, if the future evidence base supports its use.

Limitations

This study is subject to several limitations. Firstly, due to the recruitment methods employed, the small sample sizes at subgroup level and the fact that the survey may have been completed by SLTs interested in dysarthria, the views of participants included in the study may not reflect majority opinion. Secondly, SLTs were recruited only through professional SLT associations. It is likely that recruitment of participants from other entities such as the public and private sectors would have yielded a larger and more representative sample. Thirdly, since survey response rate is correlated to survey length and duration, the number of open-ended questions included in this survey was limited. Inclusion of additional qualitative items would have provided additional depth and context to the concepts targeted in this research. Lastly, the survey did not differentiate between non-progressive and progressive acquired dysarthria. Since the nature and consequences of neurological disease are pivotal to dysarthria management, clustering of responses according to dysarthria progression may have yielded additional insights and different results.

CONCLUSION

Key findings of current international SLT management of dysarthria include the following: impairment is still regarded as the most important ICF domain to assess and treat in acquired dysarthria; clinicians are confident in diagnosing dysarthria; understanding of the treatment limitations of non-speech oral motor exercises as a clinical or carry-over task appears to be increasing; and the majority of respondents are employing principles of motor learning to induce neuroplasticity during treatment.

The majority of therapists were not satisfied with the overall benefits of current dysarthria treatment practice. They were most satisfied with treatments for phonation, respiration and speech rate and least satisfied with prosody and resonance treatments. Further research to provide new evidence-based treatments for dysarthria is therefore needed. NMES was of interest to SLTs internationally as a treatment method for dysarthria, supporting research into the application of this technique specifically.

ORCID

Pasquale Balzan https://orcid.org/0000-0002-2866-4541
Rebecca Palmer https://orcid.org/0000-0002-2335-7104

ENDNOTE

[1] data presented combines progressive and non-progressive dysarthria

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, [PB], upon reasonable request.

REFERENCES

Alamer, A., Melese, H. & Nigussie, F. (2020) Effectiveness of neuromuscular electrical stimulation on post-stroke dysphagia: a systematic review of randomized controlled trials. *Clinical Interventions in Aging*, 15, 1521–1531. https://doi.org/10.2147/CIA.S262596

Ballard, K.J., Robin, D.A. & Folkins, J.W. (2003) An integrative model of Speech Motor Control: a response to Ziegler. *Aphasiology*, 17(1), 37–48. https://doi.org/10.1080/729254889

Balzan, P., Tattersall, C. & Palmer, R. (2022) Non-invasive brain stimulation for treating neurogenic dysarthria: a systematic review. *Annals of Physical and Rehabilitation Medicine*, 65(5), 101580. https://doi.org/10.1016/j.rehab.2021.101580

Berenati, M., Naro, A., Calabrò, C., Torrisi, M., Cardali, S.M. & Calabrò, R.S. (2021) Is neuromuscular electrical stimulation effective in treating severe dysarthria: insights from a case study. *Innovations in Clinical Neuroscience*, 18(10-12), 23–25.

Berner, E.S. & Graber, M.L. (2008) Overconfidence as a cause of diagnostic error in medicine. *The American Journal of Medicine*, 121(5Suppl), S2–S23. https://doi.org/10.1016/j.amjmed.2008.01.001

Brancato, G., Macchia, S., Murgia, M., Signore, M., Simeoni, G., Blanke, K., Körner, T., Nimmergut, A., Lima, P., Paulino, R. & Hoffmeyer-Zlotnik, J. (2006) Handbook of recommended practices for survey development and testing in the European Statistical System. Retrieved from http://ec.europa.eu/eurostat/ramon/statmanuals/files/Handbook_of_Practices_for_Quest.pdf

Byeon, H. (2020) Combined effects of NMES and Mendelsohn Maneuver on the swallowing function and swallowing-quality of life of patients with stroke-induced sub-acute swallowing disorders. *Biomedicines*, 8(1), 12. https://doi.org/10.3390/biomedicines8010012

Chang, S.-E., Kenney, M.K., Loucks, T.M.J., Poletto, C.J. & Ludlow, C.L. (2009) Common neural substrates support speech and non-speech vocal tract gestures. *Neuroimage*, 47(1), 314–325. https://doi.org/10.1016/j.neuroimage.2009.03.032

Collis, J. & Bloch, S. (2012) Survey of UK speech and language therapists' assessment and treatment practices for people with progressive dysarthria. *International Journal of Language & Communication Disorders*, 47(6), 725–737. https://doi.org/10.1111/j.1460-6984.2012.00183.x

Conway, A. & Walshe, M. (2015) Management of non-progressive dysarthria: practice patterns of speech and language therapists in the Republic of Ireland. *International Journal of Language & Communication Disorders*, 50(3), 374–388. https://doi.org/10.1111/1460-6984.12143

Coslett, H.B. (2016) Noninvasive brain stimulation in aphasia therapy: lessons from TMS and tDCS. In: Hickok, G. & Smalls, S.L. (Eds.) *Neurobiology of language*. New York: Elsevier.

Covey, J. (2007) A meta-analysis of the effects of presenting treatment benefits in different formats. *Medical Decision Making*, 27(5), 638–654. https://doi.org/10.1177/0272989x07306783

Darley, F.L., Aronson, A.E. & Brown, J.R. (1975) *Motor speech disorders*. Philadelphia: Saunders.

Dickson, S., Barbour, R.S., Brady, M., Clark, A.M. & Paton, G. (2008) Patients' experiences of disruptions associated with post-stroke dysarthria. *International Journal of Language & Communication Disorders*, 43(2), 135–153. https://doi.org/10.1080/13682820701862228

Dykstra, A.D., Hakel, M.E. & Adams, S.G. (2007) Application of the ICF in reduced speech intelligibility in dysarthria. *Seminars in Speech and Language*, 28(4), 301–311. https://doi.org/10.1055/s-2007-986527

Duffy, J.R. (1995) *Motor speech disorders: Substrates, differential diagnosis, and management*. St. Louis, MO: Elsevier

Duffy, J.R. (2019) *Motor speech disorders: Substrates, differential diagnosis, and management*, 4th edition, St. Louis, MO: Elsevier.

Enderby, P. & Palmer, R. (2008) Frenchay dysarthria assessment–Second edition *(FDA-2)*. Austin, TX: Pro-Ed.

Gracia, N., Rumbach, A. & Finch, E. (2020) A survey of speech-language pathology treatment for non-progressive dysarthria in Australia. *Brain Impairment*, 21(2), 173–190. https://doi.org/10.1017/BrImp.2020.3

Hawthorne, K. & Fischer, S. (2020) Speech-language pathologists and prosody: clinical practices and barriers. *Journal of Communication Disorders*, 87, 106024. https://doi.org/10.1016/j.jcomdis.2020.106024

Hlatshwako, T.G., Shah, S., Kosana, P., Adebayo, E., Hendriks, J., Larsson, E.C., … Tucker, J.D. (2021) Online health survey research during COVID-19. *Lancet Digital Health*, 3(2), e76–e77. https://doi.org/10.1016/s2589-7500(21)00002-9

Kroker, C., Schock, A. & Steiner, J. (2018) *Dysarthrie als Störung des Zeittaktes*, 1st edition, Idstein: Schulz-Kirchner Verlag.

Maas, E., Robin, D.A., Austermann Hula, S.N., Freedman, S.E., Wulf, G., Ballard, K.J. & Schmidt, R.A. (2008) Principles of motor learning in treatment of motor speech disorders. *American Journal of Speech-Language Pathology*, 17(3), 277–298. https://doi.org/10.1044/1058-0360(2008/025)

Mackenzie, C., Muir, M. & Allen, C. (2010) Non-speech oro-motor exercise use in acquired dysarthria management: regimes and rationales. *International Journal of Language & Communication Disorders*, 45(6), 617–629.

Miller, G.E. (1990) The assessment of clinical skills/competence/performance. *Academic Medicine: Journal of the Association of American Medical Colleges*, 65(9Suppl), S63–S67. https://doi.org/10.1097/00001888-199009000-00045

Miller, N. (2013) Measuring up to speech intelligibility. *International Journal of Language and Communication Disorders*, 48(6), 601–612.

Miller, N. & Bloch, S. (2017) A survey of speech-language therapy provision for people with post-stroke dysarthria in the UK. *International Journal of Language & Communication Disorders*, 52(6), 800–815. https://doi.org/10.1111/1460-6984.12316

Mitchell, C., Bowen, A., Tyson, S., Butterfint, Z. & Conroy, P. (2017) Interventions for dysarthria due to stroke and other adult-acquired, non-progressive brain injury. *The Cochrane Database of Systematic Reviews*, 1(1), CD002088. https://doi.org/10.1002/14651858.CD002088.pub3

Morgan, A.T. & Vogel, A.P. (2008) Intervention for dysarthria associated with acquired brain injury in children and adolescents. *The Cochrane Database of Systematic Reviews*, 2008(3), CD006279. https://doi.org/10.1002/14651858.CD006279.pub2

O'Cathain, A. & Thomas, K.J. (2004) Any other comments?' Open questions on surveys—a bane or a bonus to research? *BMC Medical Research Methodology*, 4, 25. https://doi.org/10.1186/1471-2288-4-25

Park, J.W., Kim, Y., Oh, J.C. & Lee, H.J. (2012) Effortful swallowing training combined with electrical stimulation in post-stroke dysphagia: a randomized controlled study. *Dysphagia*, 27(4), 521–527. https://doi.org/10.1007/s00455-012-9403-3

Ramsberger, G. & Rende, B. (2002) Measuring transactional success in the conversation of people with aphasia. *Aphasiology*, 16(3), 337–353, https://doi.org/10.1080/02687040143000636

Riemer, M., Kelley, S.D., Casey, S. & Taylor Haynes, K. (2012) Developing effective research-practice partnerships for creating a culture of evidence-based decision making. *Administration and Policy in Mental Health and Mental Health Services Research*, 39(4), 248–257. https://doi.org/10.1007/s10488-011-0368-6

Rumbach, A.F., Finch, E. & Stevenson, G. (2019) What are the usual assessment practices in adult non-progressive dysarthria rehabilitation? A survey of Australian dysarthria practice patterns. *Journal of Communication Disorders*, 79, 46–57. https://doi.org/10.1016/j.jcomdis.2019.03.002

Sandars, J. (2016) Getting research into practice: the challenge for improvement in healthcare. *Journal of Health Specialties*, 4(3), 173. https://doi.org/10.4103/2468-6360.186483

Smith, A. (1992) The control of orofacial movements in speech. *Critical Reviews in Oral Biology & Medicine*, 3(3), 233–267. https://doi.org/10.1177/10454411920030030401

Sullivan, G.M. & Artino, A.R. jr. (2013) Analyzing and interpreting data from likert-type scales. *Journal of Graduate Medical Education*, 5(4), 541–542. https://doi.org/10.4300/jgme-5-4-18

Summaka, M., Harati, H., Hannoun, S., Zein, H., Koubaisy, N., Fares, Y. & Nasser, Z. (2021) Assessment of non-progressive dysarthria: practice and attitude of speech and language therapists in Lebanon. *BMC Neurology*, 21(1), 450. https://doi.org/10.1186/s12883-021-02484-2

Tache-Codreanu, D.L. & Cucu, C.D. (2020) The neuromuscular electrical stimulation associated with speech therapy exercises in dysphagia and dysarthria after stroke (clinical case). *Journal of Sport and Kinetic Movement*, 35(1), 42–48.

Takai, O., Brown, S. & Liotti, M. (2010) Representation of the speech effectors in the human motor cortex: somatotopy or overlap? *Brain and Language*, 113(1), 39–44. https://doi.org/10.1016/j.bandl.2010.01.008

Taylor, H. (2000) Does internet research work? Comparing electronic survey results with telephone survey. *International Journal of Market Research*, 42(1), 51–63.

Titler, M.G. (2008) The evidence for evidence-based practice implementation. In: Hughes, R.G. (Ed.) *Patient safety and quality: an evidence-based handbook for nurses*. Rockville, MD: Agency for Healthcare Research and Quality.

Tourangeau, R. (1984) Cognitive science and survey methods: A cognitive perspective. In: Jabine, T., et al. (Eds.) *Cognitive Aspects of Survey Methodology: Building a Bridge between Disciplines*. Washington DC: National Academy Press, pp. 73–100.

Trupe, L.A., Mulheren, R.W., Tippett, D., Hillis, A.E. & González-Fernández, M. (2018) Neural mechanisms of swallowing dysfunction and apraxia of speech in acute stroke. *Dysphagia*, 33(5), 610–615. https://doi.org/10.1007/s00455-018-9879-6

Vogt, F., Hall, S., Hankins, M. & Marteau, T.M. (2009) Evaluating three theory-based interventions to increase physicians' recommendations of smoking cessation services. *Health Psychology*, 28(2), 174–182. https://doi.org/10.1037/a0013783

World Health Organization. (2001) *International classification of functioning, disability and health: ICF*. World Health Organization. https://apps.who.int/iris/handle/10665/42407

Yang, C.-W., Yen, Z.-S., McGowan, J.E., Chen, H.C., Chiang, W.-C., Mancini, M.E., Soar, J., Lai, M.-S. & Ma, M.H.-M. (2012) A systematic review of retention of adult advanced life support knowledge and skills in healthcare providers. *Resuscitation*, 83(9), 1055–1060. https://doi.org/10.1016/j.resuscitation.2012.02.027

Yorkston, K.M. (1996) Treatment efficacy: dysarthria. *Journal of Speech and Hearing Research*, 39(5), S46–S57. https://doi.org/10.1044/jshr.3905.s46

Yorkston, K.M. & Beukelman, D.R. (1981b) *Assessment of intelligibility of dysarthric speech*. Tagard, OR: C.C. Publications.

Yorkston, K.M., Hakel, M., Beukelman, D.R. & Fager, S. (2007) Evidence for effectiveness of treatment of loudness, rate, or prosody in dysarthria: a systematic review. *Journal of Medical Speech-Language Pathology*, 15(2), xi–xxxvi.

Yorkston, K.M., Spencer, K.A. & Duffy, J.R. (2003) Behavioral management of respiratory/phonatory dysfunction from dysarthria: a systematic review of the evidence. *Journal of Medical Speech-Language Pathology*, 11(2), xiii–xxxviii.

Yorkston, K.M., Spencer, K., Duffy, J., Beukelman, D., Golper, L.A., Miller, R., Strand, E. & Sullivan, M. (2001) Evidence-based practice guidelines for dysarthria: management of velopharyngeal function—Academy of Neurologic Communication Disorders and Sciences: writing committee for Practice Guidelines in Dysarthria. *Journal of Medical Speech-Language Pathology*, 9(4), 257–274.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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