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Characteristics of Dysarthria in Post-Stroke Patients

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Abstract

Dysarthria is a motor speech disorder caused by damage to the central nervous system. It is characterized by uncoordinated movements of the orofacial muscles. Several types of dysarthria can develop as a consequence of stroke, traumatic brain injury, and other neurological conditions. The aim of this study was to analyse the characteristics of dysarthria in patients who have suffered a stroke. The sample consisted of 30 patients undergoing rehabilitation at the *Institute for Physical Medicine, Rehabilitation and Rheumatology, „Dr Simo Milošević"* in Igalo, Herceg Novi. The assessment tools used were the *Screening Test for Dysarthria* and the *Test for Evaluation of Articulation.* The results showed that stroke patients exhibited different types of dysarthria, with characteristics varying according to the site of nervous system damage. Speech in these patients was primarily characterized by disorders of articulation and phonation. Spastic dysarthria was the most common type observed.

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Introduction

Dysarthria is a motor speech disorder primarily manifested through deficits in articulation and speech production, along with impaired movements of the speech organs (Vuković, 2019a). It results from neurological damage affecting the central and/or peripheral nervous system (Duffy, 2013; Vuković, 2010). Typically, dysarthria presents as slowness, imprecision, and incoordination of the speech musculature (Vuković, 2019a). It may affect all components of speech production, including respiration, phonation, resonance, articulation, and prosody (Vuković, 2019a; Duffy, 2013).

Based on the timing of onset, dysarthria is classified into developmental dysarthria, occurring due to nervous system damage during the prenatal or perinatal period, and acquired dysarthria, which primarily results from cerebrovascular diseases, traumatic brain injuries, and neurodegenerative disorders (Vuković, 2019a; 2019b; Fuchs & Rochet-Capellan, 2021). In acquired dysarthria, all aspects of speech production—respiration, resonance, articulation, phonation, and prosody—can be affected (Vuković, 2010; 2019b).

The main causes of dysarthria in adults are cerebrovascular diseases, which are classified into focal and diffuse types (Vuković, 2019b). Focal cerebrovascular disorders include stroke and transient ischemic attack (TIA), whereas diffuse types encompass atherosclerosis and hypertensive encephalopathy (Vuković, 2019b). Stroke, or brain infarct, is the most frequent cerebrovascular event and is characterized by sudden neurological symptoms lasting more than 24 hours (Portegies et al., 2016; Thorvaldsen et al., 1995). TIAs produce similar symptoms but resolve within one hour (Elter et al., 2003; Vuković, 2019c).

There are two main types of strokes: ischemic and haemorrhagic (Vuković, 2019b). Ischemic stroke results from an obstruction in blood flow leading to deprivation of oxygen and nutrients to the brain tissue, causing functional loss in the affected brain area (Steven & Freske, 2021; Vuković, 2019c). Haemorrhagic stroke involves rupture of a blood vessel with subsequent bleeding into the brain parenchyma, often resulting in an intracerebral hematoma (Montano et al., 2021; Vuković, 2019c).

Dysarthria is reported in approximately 20–42% of stroke patients, depending on the sample and methodology, making it a common but often under-recognized sequela of stroke (Flowers et al., 2013; Yorkston et al., 2010). Despite its prevalence, detailed investigations into the specific characteristics of dysarthria in post-stroke populations remain relatively scarce (Dalton et al., 2014).

An overview of the literature indicates that dysarthria manifests in several clinical forms, which differ based on the neurological lesion site and clinical features. These include flaccid, spastic, ataxic, hypokinetic, hyperkinetic, and mixed dysarthria types (Duffy, 2013; Vuković, 2010; 2019a). Each type is associated with distinct speech characteristics and may relate to the underlying neurological pathology.

Given the heterogeneity of dysarthria presentations and their profound impact on communication effectiveness, social participation, and quality of life (Yorkston et al., 2010; Vuković et al., 2023), understanding these variations is critical for targeted rehabilitation. However, due to variability in lesion location and severity, as well as individual patient factors, characterization of dysarthria in stroke remains a complex clinical challenge (Dalton et al., 2014; Duffy, 2013).

Considering the above and the current gaps in research, our aim was to establish the clinical characteristics of dysarthria in patients who have suffered a stroke. Ultimately, this study seeks to contribute to a more precise understanding of the nature of dysarthria following

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stroke and to support the development of more individualized and effective therapeutic interventions.

Methodology

The sample included 30 patients who had experienced a stroke and presented with clinically manifest speech disorders. This sample consisted of 15 male and 15 female respondents, aged between 19 and 85 years (with a mean age of 66). All participants had a confirmed brain infarction, verified by computed tomography or magnetic resonance imaging. Additional inclusion criteria were: absence of other neurological or psychiatric disorders, no history of speech and language development disorders, and absence of aphasia or speech apraxia.

Test Instruments and Procedure

The research employed the *Screening Test for Dysarthria* (Vuković, 2019a). Following authorization from the test's author, each patient provided written informed consent prior to participation. Personal data (year of birth, occupation) were collected directly from the patients, while clinical data related to stroke onset and diagnosis were obtained from their medical records.

The *Screening Test for Dysarthria* (Vuković, 2019a) assesses core parameters of speech production: respiration, phonation, resonance, and articulation. Patients were instructed to respond to some questions with "yes" or "no," while other tasks involved imitative responses, such as voice production or movement following verbal instructions from the examiner. During the articulation assessment, an additional test—the *Articulation Assessment Test* (Vasić, 1981)—was used to evaluate speech quality in three word positions: initial, medial, and final.

Data were analysed using the SPSS software package. To examine statistical relationships, we used the non-parametric chi-square test to determine the existence of statistically significant associations. Additionally, Fisher's exact test and Cramer's V coefficient were employed to assess distribution equality and effect strength. One-way analysis of variance (ANOVA) was used to compare group means.

Results

The respondents in the sample were balanced by sex. Out of a total of 30 participants, 50% (n = 15) were female, and the remaining 50% were male.

Table 1

Sex Distribution of Respondents

Sex	Number of Patients	Percentage
Male	15	50%
Female	15	50%

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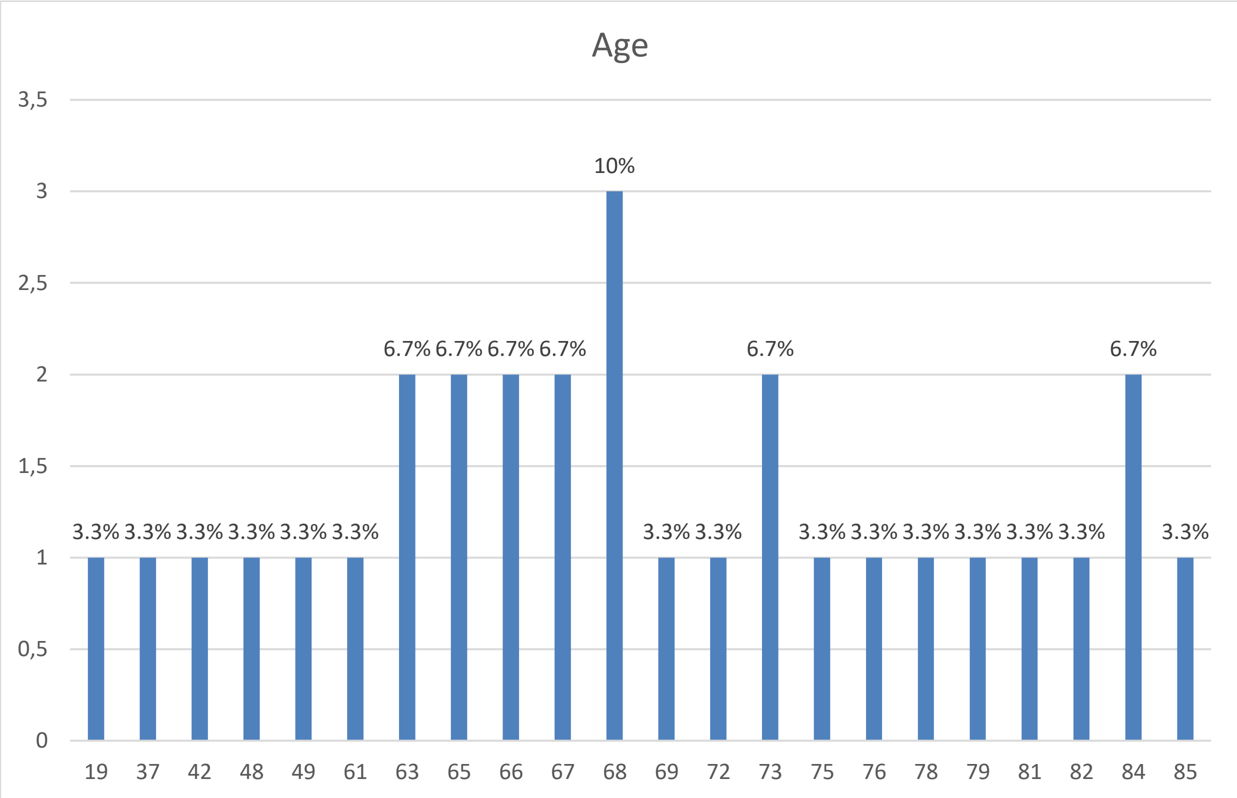
The chi-square test ($\chi^2 = 0$) indicates that there is no significant difference between the observed and expected frequencies. The sample distribution aligns with the expected proportions.

Figure 1

Age of Respondents



The age of respondents ranged from 19 to 85 years, with a mean age of 66.43 years.

Results of the Analysis of Dysarthria Characteristics

Table 2

Respiratory Function in Patients with Dysarthria After Stroke

Quality of respiratory function	**Number of patients**
Totally deviates	**1**
Partially deviates	**3**
Does not deviate	**26**
Total number of patients	**30**

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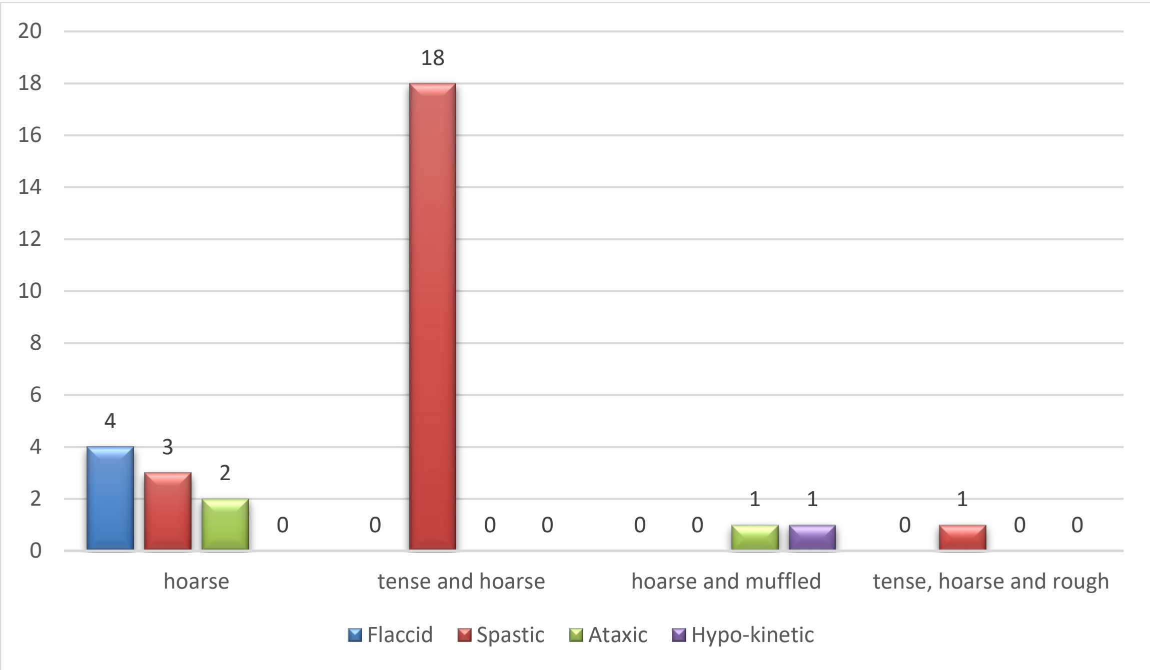
Respiratory function is one of the key indicators of dysarthric symptoms in patients following a stroke. The results showed that one patient had severely impaired respiratory function, characterized by shallow breathing and difficulties with both inspiration and expiration. Three patients exhibited partial deviations from normal respiratory patterns, while 26 patients demonstrated normal respiratory function.

Figure 2

Voice Characteristics in Respondents with Different Types of Dysarthria



Phonation is often affected in patients with dysarthria. The results of our study showed that all patients in the sample exhibited changes in voice quality. A tense and rough voice was observed in 9 patients, while a rough and muffled voice was noted in 2 patients.

One patient presented with a tense, rough, and harsh voice. In terms of resonance, no deficits were identified in any of the patient.

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Table 3

Articulation Abilities of Patients with Dysarthria

Phoneme Group	Articulation Quality	Number of Patients	TOTAL
Vowels	Changed Preserved	3 27	30
Plosives	Changed Preserved	10 20	30
Fricatives	Changed Preserved	19 11	30
Affricates	Changed Preserved	21 9	30
Nasals	Changed Preserved	4 26	30
Laterals	Changed Preserved	8 22	30
Vibrant	Changed Preserved	4 26	30

Articulation of phonemes was analysed across different phoneme groups in patients with dysarthria. Vowel articulation was most frequently preserved, with only 3 patients showing alterations. The most commonly impaired phoneme groups were affricates and fricatives, with 21 and 19 patients, respectively, demonstrating articulation deviations. Nasals, laterals, and vibrant were less frequently affected, while plosives were impaired in 10 out of 30 patients. These results reflect the known pattern in dysarthric speech, where complex articulatory movements required for affricates and fricatives are more vulnerable to disruption.

The relationship between stroke type and localization and manifestation of dysarthria

Regarding stroke type, the results of our study showed that dysarthria occurs in both ischemic and haemorrhagic strokes; however, ischemic stroke was significantly more frequent

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in our sample. Specifically, 27 patients (90%) had dysarthria resulting from ischemic stroke, while 3 patients (10%) had dysarthria following haemorrhagic stroke.

Table 4

Chi-Square Test Results: Association Between Dysarthria and Stroke Type

Test	χ^2	df	p
Pearson's chi-square	1.212[a]	3	1.000
Fisher's exact test			1.000
Effect size		φ_c	p
Cramer's coefficient		0.201	1.000

[a] *7 cells (87.5%) have expected counts less than 5. Minimum expected count is 0.10*
Significance level: $p < 0.05$

As shown in Table 4, the chi-square value is low ($\chi^2 = 1.212$). Because many expected counts were less than 5, Fisher's exact test was used, which indicated no statistically significant association between stroke type and dysarthria ($p > 0.05$). Furthermore, Cramer's coefficient ($\varphi c = 0.201$) suggests that any association present would be very weak.

Table 5

Distribution of Respondents According to Stroke Site

Type of Stroke	Lower motor neuron	Upper motor neuron	Cerebellum	Basal ganglia	Total
Ischemic stroke	4	19	3	1	27
Haemorrhagic stroke	0	3	0	0	3
Total	4	22	3	1	**30**

From Table 5, we can conclude that all three patients with haemorrhagic stroke had bleeding localized in the upper motor neuron area (central nervous system). Additionally, 73.3% of the total sample experienced stroke affecting the upper motor neurons. The smallest subgroup of patients with dysarthria (3.3%, i.e., 1 respondent) had stroke localized in the basal ganglia.

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To analyse the relationship between stroke site and dysarthria characteristics, a bivariate chi-square test was performed (see Table 5). The results indicated that stroke localization is related to the type of dysarthria, whereas the onset of dysarthria does not depend on the stroke type.

Discussion

The aim of this study was to identify the characteristics of dysarthria in patients with stroke. During the research, we used a *Screening Test for Dysarthria* (Vuković, 2019a), which evaluated key speech production processes: respiration, phonation, articulation, and resonance. Additionally, an *Articulation Test* (Vasić, 1981) was employed for a more detailed analysis of articulation quality. The characteristics of dysarthria were analysed in relation to stroke type and localization.

Our results showed that 27 patients (90%) exhibited dysarthria due to ischemic stroke, whereas only 3 patients (10%) had dysarthria caused by cerebral haemorrhage. These findings indicate that ischemic strokes are more common than haemorrhagic strokes, and that dysarthria occurs more frequently following brain ischemia. This is consistent with existing literature reporting that ischemic stroke is more prevalent than haemorrhagic stroke (Bahia et al., 2016; Summaka et al., 2022; Hoban et al., 2019; Powers et al., 2018). Additionally, Brady et al. (2016) emphasize that dysarthria is one of the most common speech impairments after stroke, with prevalence ranging between 22% and 58% in the acute phase.

Furthermore, Milovanović et al. (2022) reported that dysarthria was diagnosed in 44 out of 152 stroke patients referred for speech therapy within one year, supporting the observed frequency of dysarthria in our sample.

Regarding the localization of central nervous system damage, the majority of patients had lesions affecting the upper motor neurons, while dysarthria was identified in 4 patients with damage to the lower motor neurons. These data suggest that stroke-related dysarthria predominantly results from central nervous system injury, which aligns with findings from other authors (Summaka et al., 2022; Darley, Aronson, & Brown, 1975; Duffy, 2013).

Analysis of dysarthria symptoms showed that most patients exhibited disorders in articulation and phonation, whereas respiratory dysfunction was present in a smaller number of cases. Articulation impairments were observed across patients with flaccid, spastic, ataxic, and hypokinetic dysarthria. A more detailed examination of articulation abilities revealed difficulties across all groups of phonemes, with greater impairment in fricatives and affricates compared to other sound groups. Clinical evaluation of voice quality showed that the most frequent alterations were present in flaccid, ataxic, and hypokinetic dysarthria. These results are consistent with previous studies indicating that dysarthria, regardless of type, typically involves clinical deficits in phonation (Vuković, 2019a; Arsenić, 2019; Duffy, 2013). Moreover, as highlighted by Allison, Hustad, and McNeil (2017), chronic stroke-related dysarthria often includes deficits across multiple speech subsystems—respiration, phonation, and articulation—contributing to complex impairments in intelligibility and prosody.

Findings from our study also confirm impairments in articulation, phonation, and respiration in post-stroke patients, which suggests that these three fundamental speech production subsystems are particularly vulnerable to neurological damage caused by stroke.

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Conclusions

Based on the analysis and interpretation of the obtained results, it can be concluded that dysarthria occurs as a consequence of both ischemic and haemorrhagic stroke. However, given that ischemic strokes are significantly more frequent in clinical practice, patients with dysarthria are more commonly found in this group than among those who have suffered a cerebral haemorrhage. In terms of lesion localization, dysarthria is more often associated with strokes affecting specific regions of the central nervous system that are involved in motor speech control.

According to the findings of our research, stroke-related dysarthria can manifest as spastic, flaccid, ataxic, or hypokinetic types, with spastic dysarthria being the most frequently observed form.

Among the most prominent symptoms of dysarthria in stroke patients are articulation disorders and phonation deficits, which significantly compromise speech intelligibility and communication efficiency. These findings support previous evidence that dysarthria adversely affects both communicative competence and overall quality of life in individuals after stroke (Vuković et al., 2023).

In light of this, it is crucial to include systematic assessment of speech functions as part of the diagnostic protocol for post-stroke patients. The key goals of such evaluation should be to identify the dominant symptoms of speech disorder, determine the type of dysarthria present, and ensure timely inclusion of patients in appropriate rehabilitation programs.

Early identification and targeted intervention are essential for improving communication outcomes and enhancing the overall functional recovery of individuals affected by post-stroke dysarthria.

Conflict of interest

None.

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