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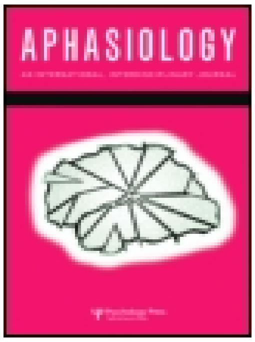

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ARTICLE

Incidence and types of aphasia after first-ever acute stroke in Bengali speakers: age, gender, and educational effect on the type of aphasia

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ABSTRACT

Background: The pattern of post-stroke aphasia in speakers of Bengali language has not previously been reported in the literature. Furthermore, the inter-relationship between age, gender, and level of education and aphasia typology has remained unsettled thus far.

Aims: To investigate the incidence and type of aphasia in first-ever acute stroke patients who were speakers of Bengali language.

Methods & Procedures: Bengali version of Western Aphasia Battery was used for language assessment in our study participants. Lesion localization was done by using magnetic resonance imaging(3T) for ischemic stroke (if not contraindicated) and computed tomography for hemorrhagic stroke. Among 515 screened cases of first-ever acute stroke, 208 presented with aphasia. Language assessment was done between 7 and 14 days in all study participants.

Outcomes & Results: The incidence of post-stroke aphasia in our sample was found at 40.39%. Types of aphasia were – Broca's (38.5%) followed by global (27.9%); Wernicke's (12.5%); transcortical motor (9.6%); anomic (4.3%); transcortical sensory (3.8%); isolation (1.9%); and conduction (1.4%). Mean number of years of formal education was significantly higher in fluent aphasia group in comparison with non-fluent group (10.51 years versus 7.01 years, $p = 0.003$). In logistic regression analysis, location of lesion (posterior perisylvian) ($p = 0.007$, OR = 5.406, 95% CI, 1.602–18.240) and education ($p = 0.044$, OR = 1.097, 95% CI, 1.003–1.199) were two independent predictors favoring fluent aphasia.

Conclusions: Aphasia among post-stroke Bengali patients is quite frequent. The commonest type of aphasia in our sample was Broca's aphasia. Bengali-speaking people with higher education were more likely to present fluent aphasia.

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Introduction

Aphasia, a well-known focal neurologic deficit following stroke, has been defined as a disorder of language that is acquired secondary to brain damage (Benson & Ardila,

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1996). While several institution-based studies across the globe have reported the frequency of post-stroke aphasia to be between 20% and 41% (Bohra et al., 2015; Dickey et al., 2010; Flowers et al., 2016; Pauranik et al., 2019; Pedersen, Vinter, & Olsen, 2004), a large community-based study from Switzerland documented that as many as 43 per 100,000 inhabitants are affected by stroke-induced language disorder (Engelter et al., 2006). Besides revealing the burden of language dysfunction among stroke patients, the aforementioned data also bring out the important fact that the frequency of post-stroke aphasia is variable across different populations. Disagreement in the literature is also obvious regarding the spectrum of post-stroke aphasia subtypes (Hoffmann & Chen, 2013), despite it being a common mode of presentation among stroke patients. Although heterogeneity in this context has somewhat been contributed by time-point and tool of language assessment following stroke, these parameters do not seem sufficient to explain the observed variability among different study results.

Data from Indian sub-continent in this context, however, were inadequate and based on relatively smaller samples (Azhar, Maqbool, Butt, Iftikhar, & Iftikhar, 2017; Bohra et al., 2015). Therefore, in a recent expert group meeting on aphasia in India the necessity of "hospital based databank on the prevalence of aphasia from stroke registries across the country" was duly recognized (Pauranik et al., 2019). The people of India present high degree of diversity in their languages and dialects (https://www.ethnologue.com/country/IN). Further exploration of aphasia frequency and symptomatology in this population deserves attention in the interest of fundamental language research.

Cross-linguistic variability in frequency as well as symptoms of aphasia has been acknowledged in literature for a long time (Bastiaanse et al., 2011; Bastiaanse, Edwards, & Kiss, 1996; Bates & Wulfeck, 1989; Bates, Wulfeck, & MacWhinney, 1991; Paradis, 2001). As a corollary to that, the possibility of dissimilar brain organization of language across speakers of different languages has also been recognized by researchers, particularly in reference to non-western languages. Bless et al. (2015) conducted an extensive dichotic listening study using a smartphone application for remote data collection. They included 4000 participant speakers from more than 60 different languages. It was found that left-hemispheric dominance for language is a general phenomenon; however, the linguistic background significantly affects the degree of lateralization. Implication of these observations extends to prognosis and therapy of post-stroke participants with aphasia. Thus, exploring aphasia across different languages is not only of theoretical interest but also of clinical importance. To the best of our knowledge, data on post-stroke aphasia were not available in Bengali language. Bengali is an Indo-Aryan language with about 260 millions of native speakers, 83 millions of them living in India (https://www.ethnologue.com/country/IN).

The effect of demographic factors (age and gender) on type of aphasia has been studied for some time now. It has been observed that female gender (Sundet, 1988) and older age (Bhatnagar, 2002) predispose to fluent aphasia. However, recent view in this context attaches more importance to age rather than gender (Wallentin, 2018).

Existing literature is unanimous regarding the effect of education on post-stroke aphasia severity. People with higher background education have been observed to suffer less severe aphasia and also they tend to recover faster compared to their lower educated counterparts (Connor, Obler, Tocco, Fitzpatrick, & Albert, 2001; Gonzalez-Fernandez et al., 2011). Increased cognitive reserve in higher educated participants may be a possible explanation for this finding (Staff, Murray, Deary, & Whalley, 2004) although this theory is better accounted for in the arena of degenerative dementia (Garibotto et al., 2008; Roe, Xiong, Miller, & Morris, 2007) and very few studies have actually approached the question of cognitive reserve in the field of stroke (Elkins et al., 2006).

The evidence however is far from sufficient when the question comes to investigating the effect of education on aphasia type. Some reports hinted that the educational level can affect the brain organization of language, and hence, aphasia symptomatology. Comparing Portuguese-speaking literate and illiterate aphasia patients, it has been proposed that cerebral representation of language is more ambilateral in illiterate participants than it is in school educated participants. Although left cerebral "dominance" remains the rule in both (Coppens, Parente &Lecours, 1998; Lecours et al., 1987), a proposition which can be related to "novelty-routinized principle of brain organization" that is beyond language literates and illiterates (MacNeilage, Rogers &Vallortigara, 2009). Some degree of word-finding difficulty and reduction in speech output as well as sizeable production of phonemic paraphasias have been reported in right-stroke illiterate by Lecours et al. (1988), although the effect of literacy on language dominance was not clearly established in this study. Taken together, inter-relationship between education and aphasia typology remains unsettled in the literature. Therefore, it would be relevant to further explore if the level of education exerts any influence on the initial symptoms of aphasia, which in turn might help us know the impact of formal education on language network itself and answer a crucial question – if components of language network are differentially affected by exposure to education.

In the present study, we intended to investigate the incidence and type of aphasia in first-ever acute stroke patients who were speakers of Bengali language. An attempt was also made to explore if age, gender, and number of years of formal education had any impact on clinical phenotype of aphasia in the study participants.

Methods

We conducted an observational study in the stroke unit of a tertiary care neurology teaching hospital of eastern India on participants with first-ever stroke over a period of 2 years (2016–2018). The study was initiated with prior approval from the Institutional Ethics Committee.

Participants

Consecutive patients with first-ever acute stroke presenting to our stroke unit were recruited for the present study. The inclusion criteria were: (1) adult (>18 years) literate participants with aphasia due to first-ever stroke; (2) conscious (according to WHO definition) at the time of language assessment; and (3) Bengali speakers. The following exclusion criteria were used: (1) aphasia caused by vascular catastrophe inside intra-cranial space-occupying lesion; (2) pre-morbid psychiatric illness affecting communication (such as personality disorder); (3) pre-morbid dementia (documented or suspected); (4) alcohol or drug abuse; and (5) significant non-linguistic cognitive disturbance.

During the study period, a total of 607 patients of first-ever stroke were recruited following the inclusion and exclusion criteria. Ninety-two patients were further excluded due to the following reasons: death before initial assessment of language (33); severe systemic complications in early post-stroke phase (25); complete reversal of aphasia before first assessment (12) and severe dysarthria or anarthria hindering language assessment (15); extensive bilateral microvascular ischemic changes (7).

Edinburgh's handedness inventory (Oldfield, 1971) was used as a formal test to determine the right-handedness of the study participants. Right-handed participants (509) were absolute majority in the sample while only 5 were left-handed and 1 patient was ambidextrous.

Language examination

The Bengali version of Western Aphasia Battery (BWAB), a validated tool for assessing the language function in adults, was used to pinpoint the presence, severity, and type of aphasia (Keshree, Kumar, Basu, Chakrabarty, & Kishore, 2013). The parameters of BWAB included Spontaneous Speech, Comprehension, Repetition, Naming, and Aphasia Quotient (AQ). The AQ is a measure of severity of language impairment and is a composite score based on the oral-auditory language subscales of Fluency, Comprehension, Repetition, and Naming. Reading and writing were assessed in our participants by using the relevant sections in BWAB. AQ below 93.8 is considered the quantitative cutoff for diagnosis of aphasia. For the purpose of the present study, aphasia types with non-fluent designation were global, Broca's, trans-cortical motor, and mixed transcortical (isolation syndrome) whereas Wernicke's, trans-cortical sensory, conduction, and anomic were labeled as fluent aphasia. Language examination in the study participants was performed between 7 and 14 days following the onset of stroke symptoms.

In the present study, bilingualism was defined as the ability to communicate in two or more languages during interaction with other speakers of these same languages (Mohanty, 1994). This definition highlights the ability for active language use rather than grammatical proficiency and hence is aligned with the current concepts of bilingualism as life-long activity rather than passive learning (Bak, 2016).

Linguistic features of Bengali

According to Ethnologue (https://www.ethnologue.com/country/IN), Bengali language has the following characteristics: subject-object-verb; postpositions; noun head both initial and final; 3 genders: male, female, neuter; content q-word initial and final; clause constituents indicated by case-marking (5 cases) and word order; verb affixes mark person, number; definite article affix; tense; passives and voice; causatives; comparatives; non-tonal; 35 consonants and 5 vowel phonemes; stress on first syllable.

Notable idiosyncratic features of Bengali language are, by and large, related to its vowel duration as well as intonational pattern. Bengali speakers moderate vowel duration only when morpheme boundaries are concerned (Bhattacharya, 2000). Long and short vowels in Bengali can distinguish between otherwise homophonous words. Echo reduplication of vowels is also a frequent linguistic feature in Bengali, possibly because open monosyllables (i.e., words that are made up of only one syllable, with that syllable ending in the main vowel and not a consonant) can have longer vowels than other syllable types (Ferguson & Chowdhury, 1960). For Bengali words, intonation or pitch of voice has minor significance, apart from a few cases such as distinguishing between identical vowels in a diphthong (Chatterji, 1921). In sentences, however, intonation plays a significant role. Phonologically assigned phrasal stress in addition to the intonational pattern in Bengali creates a musical tone to sentences, with low and high tones alternating until the final drop in pitch to mark the end of the sentence (Hayes & Lahiri, 1991).

Brain imaging

Brain imaging for ischemic strokes in the present study was performed by Siemens 3T MRI machine (Magnetom Verio DOT, 16 channels) using a standard quadrature head coil. Computed tomography scan (Philips, 16 slice) was used for initial brain imaging of participants with hemorrhagic stroke. The images were read by neuro-radiologists to determine the location of lesion. Infarcted tissue was defined as tissue having abnormal high signal on T2 weighted and/or FLAIR (Fluid-attenuated inversion recovery sequences) images. Diffusion-weighted imaging was employed for detection and localization of acute infarct. Location and extent of the lesion were determined with respect to the sulcal anatomy.

Cortical lesions were divided into three categories: anterior perisylvian (lesions centered anterior to central sulcus sparing the Wernicke's area), posterior perisylvian (lesions centered posterior to central sulcus involving parieto-temporal area sparing the Broca's area), and combined antero-posterior lesions (involving both Broca's and Wernicke's areas). Lesions which did not reveal any cortical involvement and were limited to subcortex only were designated as pure sub-cortical strokes. Pure sub-cortical lesions were divided into four categories: basal ganglia, thalamus, para-ventricular white matter, and striato-capsular.

Statistical analysis

Statistical analyses were performed using SPSS latest version. Univariate analysis for categorical variable (gender) was performed using chi-square and Fischer's exact test (as applicable). For continuous variables (age and number of years of formal education), comparisons were performed using independent *t*-test or non-parametric tests (Mann–Whitney U test; Kruskal–Wallis H test) or one-way analysis of variance (ANOVA) as applicable. For logistic regression analysis, demographic factors (age, gender, lesion location, and number of years of formal education) were taken as independent variables while the type of aphasia (non-fluent versus fluent) was taken as the dependent variable.

Results

During the study period, 515 screened cases (after exclusion of 92 cases) of first-ever stroke were included, among which 208 patients presented aphasia (see Table 1). The

Table 1. Distribution of demographic factors; stroke-related factors and aphasia severity according to aphasia types in the study population.

	Global	Broca's	Isolation	TCM	Wernicke's	TCS	Conduction	Anomic
N (%)	58 (27.9)	79 (38.5)	4 (1.9)	20 (9.6)	27 (12.5)	8 (3.8)	3 (1.4)	9 (4.3)
Age (years) (SD)	54.97 (7.0)	50.08 (13.2)	56.50 (1.0)	50.55 (12.8)	56.15 (5.9)	43.75 (8.5)	45.00 (8.5)	52.56 (12.5)
Gender, males (%)	44 (75.9)	53 (67.0)	4 (100)	11 (55)	16 (59.3)	8 (100)	0 (0)	8 (88.9)
Education (years) (SD)	7.71 (4.9)	6.43 (3.4)	4.50 (5.0)	7.75 (3.3)	10.70 (7.2)	12.75 (4.9)	8.33 (6.4)	8.67 (5.6)
Ischemic stroke, *N* (%)	14 (24.1)	63 (79.7)	4 (100)	20 (100)	24 (88.9)	8 (100)	1 (33.3)	8 (88.9)
AQ (SD)	3.46 (1.2)	7.02 (3.1)	54.0 (-)	68.46 (20.4)	4.65 (1.0)	79.45 (0.9)	76 (4.8)	83.02 (2.7)
NIHSS (SD)	16.91 (3.2)	17.65 (2.6)	9.50 (2.6)	8.25 (3.7)	17.15 (2.9)	9.62 (2.5)	9.00 (4.4)	8.89 (2.2)

AQ – Aphasia Quotient; NIHSS – National Institute of Health Stroke Scale; TCM – trans-cortical sensory; TCS – trans-cortical sensory incidence of post-stroke aphasia in our sample was found to be 40.39% (208/515). The mean age of patients with aphasia was 52.19 years (SD = 10.96) with male/female ratio of 2.25:1. The ratio of ischemic/hemorrhagic stroke in our sample of participants with aphasia was 1.97:1 (67:34). Proportion of participants presenting aphasia between ischemic and hemorrhagic stroke did not differ significantly (0.40 versus 0.39). Among the participants with aphasia, 53 (25.48%) qualified as bilingual and rest 155 were monolinguals.

Cortical or cortico-subcortical mixed lesions were observed in 70.19% (146/208) of the participants with aphasia with the most frequent location being anterior perisylvian (71/146, 48.63%) followed by posterior perisylvian (58/146, 39.72%), and the last, combined antero-posterior lesions combined (17/146, 11.65%). Aphasia due to pure sub-cortical stroke was found in 29.81% (62/208) of people with aphasia (see Table 2). The location of sub-cortical strokes with aphasia (n = 62) were (in descending order of frequency): basal ganglia (53.23%); striato-capsular (33.87%); thalamus (6.45%; and para-ventricular white matter (6.45%). The frequency of crossed aphasia in our study participants was 6.73% (details of this finding have been discussed by the authors in a separate paper) (Lahiri et al., unpublished).

The commonest type of aphasia in our sample was Broca's (38.5%) followed by global (27.9%); Wernicke's (12.5%); trans-cortical motor (9.6%); anomic (4.3%); transcortical sensory (3.8%); mixed transcortical or isolation (1.9%); and conduction (1.4%). Non-fluent aphasia was observed in 77.88% (162/208) of cases as a whole. Among people with pure sub-cortical aphasia, 87.09% (54/62) had non-fluent aphasia. Most frequent sub-cortical aphasia was global type (48.39%) followed by Broca's aphasia (22.58%).

On univariate analysis, age (p = 0.988) and gender (p = 0.847) did not have significant effect on the type of aphasia. Mean number of years of formal education was significantly higher in fluent aphasia group in comparison with non-fluent group (10.51 years versus 7.01 years, p = 0.003). In *post hoc* analysis, people with transcortical sensory and Wernicke's aphasia were found to be higher educated (12.75and 10.70 years, respectively) in comparison to people with any other aphasia phenotypes (see Table 3 and Figure 1). In logistic regression analysis, location of lesion (posterior perisylvian) (p = 0.007, OR = 5.406, 95% CI, 1.602–18.240) and education (p = 0.044, OR = 1.097, 95% CI, 1.003–1.199) were two independent predictors favoring fluent aphasia. The overall predictive value of the model was 87.5%.

Discussion

To the best of our knowledge, this is a first-time observation of the frequency and pattern of post-stroke aphasia in Bengali-speaking participants.

Table 2. Distribution of aphasia phenotypes according to lesion location (adapted from Lahiri et al., unpublished).

	Global	Broca's	Isolation	TCM	Wernicke's	TCS	Conduction	Anomic	Total (%)
Anterior lesion	4	58	0	9	0	0	0	0	71 (34.13)
Posterior lesion	8	8	3	0	27	7	3	2	58 (27.88)
Combined	16	1	0	0	0	0	0	0	17 (8.17)
Sub-cortical	30	12	1	11	0	1	0	7	62 (29.80)

Table 3. Logistic regression analysis for factors favoring fluent aphasia.

Parameters	Significance	OR	95% CI
Age	0.912	1.003	0.946–1.064
Gender	0.057	3.123	0.969–10.067
Education	0.044	1.097	1.003–1.199
Location (Posterior peri-sylvian)	0.007	5.406	1.602–18.240

CI – confidence interval; OR – odd's ratio.

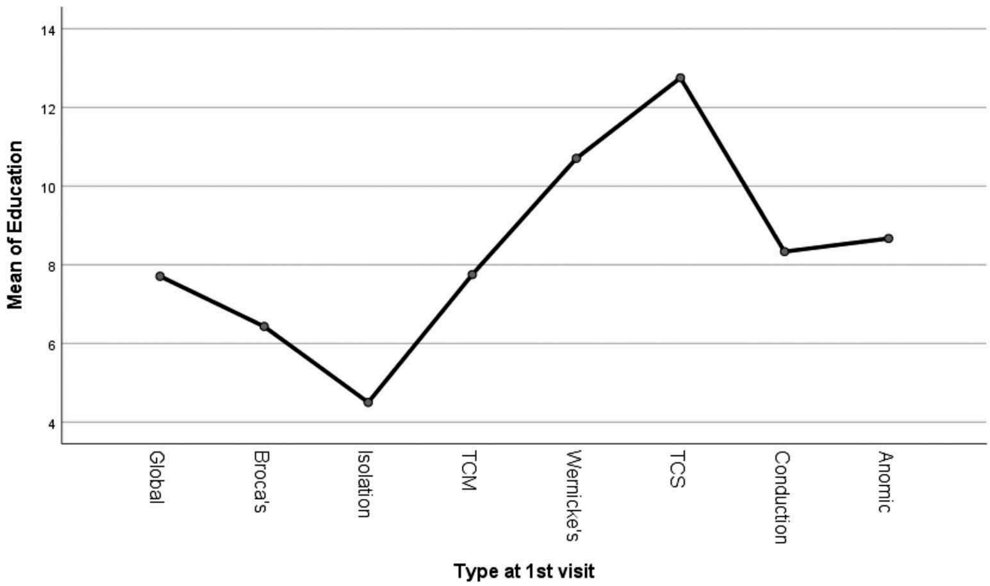

Figure 1. Means plot of education (in terms of number of years of formal education) across different aphasia types.

Frequency of post-stroke aphasia

In the existing literature, there is appreciable variability regarding the reported frequency of stroke-induced aphasia. A recent large study from the USA on aphasia in sub-acute stroke of mixed etiology documented the incidence of post-stroke aphasia to be 34.8% (625 of 1796) (Hoffmann & Chen, 2013). Similar results were also previously obtained in studies by Dickey et al. (2010) from Canada and by Tsouli et al. (2009) from Greece, both of which reported the frequency of stroke aphasia as 35%. The tally of post-stroke aphasia from England, nevertheless, revealed considerable variability as two large studies (Graham, Crichton, Koutroumanidis, Wolfe, & Rudd, 2013; Guyomard et al., 2009) documented quite different figures (27% versus 41%). On the contrary, lower values were found in similar studies with sizeable sample from Italy (Bersano, Burgio, Gattinoni, & Candelise, 2009) and Spain (Roquer, Campello, & Gomis, 2003) (28% and 25%, respectively). A contemporary German study (Jauss et al., 2007) with large sample size (n = 5488) documented quite a high frequency (62%) of stroke-induced aphasia which clearly stands out in background of these aforementioned data.

Two older studies (Karanth & Rangamani, 1988; Nair & Virmani, 1973) from India reported relatively higher frequency (around 50%) of post-stroke aphasia. In a recent paper from northern India, which included Hindi-speaking participants with both acute and chronic first-ever strokes of mixed etiology, the incidence of post-stroke aphasia was observed around 28% (Bohra et al., 2015). The frequency of post-stroke aphasia in our study was found to be 40.39% among Bengali-speaking patients with first-ever acute stroke of mixed etiology. This figure is slightly on the higher side as far as the incidence of post-stroke aphasia is concerned in the literature. Furthermore, Flowers et al. (2016) mentioned that use of standardized test battery, rather than clinical evaluation, for diagnosis of aphasia in post-stroke participants may be a reason behind certain studies reporting relatively higher incidence of aphasia. Relative higher frequency of aphasia documented in our sample may possibly reflect the application of a test battery (BWAB) for diagnosis of the phenomenon in question. The absolute majority of dextral participants in the present sample might have also influenced the incidence of aphasia. Nevertheless, it is postulated in the literature that brain representation of language may vary across speakers of different languages (Bless et al., 2015). Documentation of aphasia frequency after stroke in different languages therefore becomes important for better exploration of the underpinnings of language network in the brain. The current study, however, is not specifically designed to test the hypothesis of variability in neural representation of languages.

Types of post-stroke aphasia

The commonest type of aphasia after stroke in our sample was Broca's aphasia followed by global aphasia. However, in a recent study from North India (Bohra et al., 2015), global aphasia was the most common type of aphasia after first-ever stroke. The Copenhagen aphasia study (Pedersen et al., 2004) also demonstrated global aphasia to be most frequent type of aphasia after first-ever acute stroke. The apparent dissimilarity between our observation and the aforementioned studies may be linked to distribution of stroke location among our study participants. Around one-third (71/208, 33.2%) of our participants had anterior peri-sylvian (pure cortical or cortico-subcortical) stroke, which may be the reason why Broca's aphasia was relatively more frequent in our sample. In line with our observation, the study by Hoffmann and Chen (2013) also demonstrated Broca's aphasia to be most frequent (27.2%) among the aphasia subtypes. However, Western Aphasia Battery was not used as language assessment tool in this particular study and evolution from one subtype to another in the acute and sub-acute post-stroke phase led to diagnosis of more than 1 subtype among the participants.

As a whole, preponderance toward non-fluent aphasia (77%) was observed in the study participants, which is similar to the observation made by Bohra et al. (2015). No significant age or gender difference was found between groups with non-fluent and fluent type of aphasia. This finding is in contradistinction to some of the previous studies which concluded fluent aphasia is more frequent in older age group (Bhatnagar, 2002). In a paper by Cappa and Vignolo (1988), female gender preponderance was reported in participants with global aphasia following anterior lesion. Sundet (1988) reported a higher incidence of female than male patients among fluent participants with higher severity of aphasia. In a recent meta-analysis by Wallentin (2018), it was concluded that aphasia rate sex difference may have been caused by age because women are typically older at the time of stroke. However, no significant age difference between genders was found in our present sample.

Effect of education on type of aphasia

The distribution of education was significantly different (p = 0.003) between non-fluent and fluent participants with aphasia. People with fluent aphasia were more educated than non-fluent. However, it can be linked to lesion location itself as posterior lesion is significantly associated with fluent aphasia and people with posterior lesion in our sample had longer duration of formal education. After adjusting for age, gender, and lesion location in the logistic regression analysis, higher education remained an important factor favoring fluent aphasia. Gonzalez-Fernandez et al. (2011) recently documented that participants with aphasia with more than 12 years of formal education made less error in several language tasks compared to their lesser educated counterparts and this observation was attributed to increased cognitive reserve in educated participants. The findings of the present study partly agree with this idea. Although definite interpretation cannot be drawn, our results suggest that in Bengali-speaking participants lower level of education might leave the fluency aspect of language more vulnerable to damage. A contemporary view is that posterior perisylvian areas, Wernicke's area in particular, contribute to language fluency mostly at the level of phonemic retrieval (Binder, 2015) although the effect of education on this particular aspect of language network is yet to be explored in the literature. In turn, increased incidence of receptive aphasia with higher education may also suggest more stringent lateralization and localization of language receptive functions in the educated participants. In a study on crossed aphasia in Bengali language by the authors (Lahiri et al., unpublished), no fluent aphasia was found in dextrals with right hemispheric stroke and possibility of bi-hemispheric representation of language in speakers of Bengali was considered. The level of education of the participants in this particular study was between 2 and 10 years, indicating a left-hemispheric advantage for receptive functions in low to middle educated Bengali-speakers as well. In light of this aforementioned observation, the present findings raise a pertinent question. Does longer exposure to Bengali language through formal education affect brain representation of language? Idiosyncrasies of language are known to influence brain representation of language. Is it possible that our observation is linked to such a phenomenon? Functional studies including healthy participants might get us closer to the answer.

Sub-cortical aphasia

A relatively higher frequency (29%) of sub-cortical aphasia was documented in the present study. This finding is in contradistinction to the study by Bohra et al. (2015) where pure sub-cortical aphasia was observed in 16.6% of participants with aphasia. Thus, our observation may seem apparently surprising if one does not bring into consideration the higher frequency of sub-cortical strokes in Bengali participants as was reported in the study by Das et al. (2007) from Kolkata. In the present study, around 34% of the stroke patients had pure sub-cortical lesion in brain imaging.

Hence, the relative higher incidence of sub-cortical aphasia in our sample may be linked to higher occurrence of pure sub-cortical strokes in the study population itself. An alternative explanation may be sought in the light of cross-linguistic variation in brain representation of language. Although it may be speculated from the presented results that sub-cortical structures might play a crucial role in language network for speakers of Bengali language, data in this regard are too inadequate at this point in time and further studies are required to elaborate this perspective better.

The most frequent sub-cortical lesion associated with aphasia in our study was hemorrhagic stroke in basal ganglia. Our observation may once again be explained by the known pattern of stroke in the present study population. Das et al. (2007) reported in their Kolkata study, basal ganglia-thalamic region to be the commonest site of intra-cerebral hemorrhage among Bengali participants. All the cases with basal ganglia stroke presented global aphasia in first assessment and hence global aphasia was the commonest type of aphasia following sub-cortical stroke in our sample. In a recent study by Kang, Sohn, Han, and Paik (2017), basal ganglia was the commonest sub-cortical structure associated with aphasia and the most frequent sub-cortical aphasia was of anomic type. A closer look at the data, however, reveals that majority (4/6) of sub-cortical global aphasia occurred following basal ganglia strokes and worst AQ scores were associated with basal ganglia strokes compared to other sub-cortical regions. Nonetheless, this was a retrospective study and the initial language assessment was delayed in comparison to our study. A similar retrospective study from India (Krishnan, Tiwari, Pai, & Rao, 2012), which assessed patients in early post-stroke phase (3–6 days), reported 50% (4/8) of pure basal ganglia related aphasia was global aphasia. Thus, a trend toward worse neurolinguistic profile following basal ganglia stroke is observable in existing literature, particularly if initial language assessment is performed in the early post-stroke phase.

Conclusion

An attempt was made in the present study to document the epidemiological aspects of post-stroke aphasia among Bengali-speaking participants. It was seen that aphasia among post-stroke Bengali patients is not uncommon with a frequency of around 40%. Although this figure is little higher in comparison with the other similar studies across the globe, it is not incoherent. A possible explanation for this relative high frequency of aphasia in our sample could be the inclusion of participants with mixed stroke etiology (ischemic as well as hemorrhagic). The most common type of aphasia in our sample was Broca’s aphasia, which possibly is a reflection of more frequent anterior peri-sylvian strokes in the study participants. Incidence of sub-cortical aphasia was also found to be on the higher side in our population which once again may be a corollary to higher occurrence of sub-cortical strokes in our part of the globe. Interestingly, preponderance toward non-fluent aphasia was observed in the study population as a whole, which is in agreement with a similar contemporary study from India performed on Hindi-speaking participants. Recent literature acknowledges the possibility of variable language representation in brain across different languages. It remains to be seen whether the vernacular language of the patients has anything to do with our present observation.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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