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# The effect of sex and education on aphasia profile and severity

## Abstract

**Background:** Aphasia is more common in men than women. This could be as a consequence that stroke is more common in men than women. Aphasia would be more severe in men than in women. A recent study showed that Broca's aphasia was more common in women than men. The relationship between education and aphasia is unclear. Education can affect the representation of language in the brain. Right-handed subjects with higher education tend to have the language more lateralized to the left, while lower education may represent bilateral.

**Aims:** The purpose of this study was to analyze the aphasia type distribution in men and women as well as the aphasia severity and its interaction with the educational level.

**Methods & procedures:** I selected a sample of aphasic patients of vascular origin of which 119 were men and 81 women with age of 57.37years (SD = 15.56 =), education of 13.52 years (SD = 4.08), and mean time post-onset of 6.58 months (SD = 12.94). Spanish versions of the Western Aphasia Battery (WAB-R) and Boston Diagnostic Aphasia Examination (BDAE) were used for language assessment.

**Outcomes & results:** There was a significant difference in education between both genders. The men had a better education. In contrast, there were no significant differences between men and women in age, severity and time of evolution. 72.73% of conduction aphasia, 66.66% of transcortical motor aphasia, 63.33% of Wernicke's aphasia and mixed non-fluent aphasia were men. Broca's aphasias are significantly more severe in men than in women

**Conclusions:** Aphasia was more frequent in men. The severity, age and time of evolution were not different between both genders in the total sample. Conduction aphasia, Wernicke's aphasia, transcortical motor aphasia, and mixed non-fluent aphasia were more frequent in men. Broca's aphasia was less severe in women.

**Keywords:** aphasia by stroke, aphasia sex and education, aphasia severity

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## Introduction

### Sex differences in aphasia

The effect of gender on aphasia has been controversial. De Renzi et al.[1] reported three general conclusions: (1) the frequency of language disorders is similar in males and females; (2) non-fluent aphasia is more frequent in males; (3) patients with Broca's aphasia are younger than individuals with Wernicke's aphasia.

Aphasia is usually found to be more prevalent in men than in woman, but this difference is the consequence of stroke distribution in men and women. Appelros, et al.[2] using a systematic review analyzed sex differences in stroke epidemiology. 98 articles were selected. The mean age at first-ever stroke was 68.6 years among men, and 72.9 years among women. Male stroke incidence rate was 33% higher and stroke prevalence was 41% higher than the female, with large variations between age bands and between populations. Furthermore, stroke tended to be more severe in women, with a 1-month case fatality of 24.7% compared with 19.7% for men. The authors concluded that worldwide, stroke is more common among men, but women are more severely ill. **Benjamin** et al.[3] report that the male-to-female ratio of stroke is 1.25 from ages 55–64 years, 1.5 from ages 65–74 years, 1.07 from ages 75–84 years, but 0.76 from age 85+years. Overall, women experience more severe strokes than men, yet the stroke survival rate is higher among women.

## Aphasia in stroke

In a recent meta-analysis, Wallentin and Torun[4] found 25 studies with a total of 48,362 stroke patients and in a second analysis, data was extracted from an American health database (with over 1,900,000 stroke patients). Both analyses revealed significantly larger aphasia rates in women than in men (1.1–1.14 ratio). When age and stroke severity were included as covariates, gender failed to explain any aphasia rate difference above and beyond that which is explained by age differences at time of stroke. In conclusion, sex does not seem to play a significant role in aphasia type, when large series of patients are examined.

Different studies report different figures: Ellis et al.[5] 18% in USA; Wallentin and Torun[4] 27.7% seemingly different countries but mostly USA; Pedersen, et al.[6] 55.3% in Denmark; Lahiri et al.[7] 40.4% in India; Gonzalez, et al.[8] 19.7% in Chile.

## Sex differences in stroke aphasia rates

Different figures have been reported. Hier et al.[9] observed aphasia in 19.4% of men and 22.5% of women. Wallentin[4] approached this question using two different strategies (1) he developed a meta-analysis of the available reports of aphasia rates in the two sexes. 25 studies corresponding to 48,362 stroke patients were found, for which aphasia rates were calculated. (2) data were taken from an American health database, which includes 1,967,038 stroke patients. This

second group was used in order to include age and stroke severity into a regression analysis of sex differences in aphasia rates. Both analyses indicated that there are slightly but significantly larger aphasia rates of aphasia in women than in men (1.1–1.14 ratio). When age and stroke severity were included as covariates, sex failed to explain any aphasia rate sex difference above and beyond that which is explained by age differences at time of stroke.

## Sex differences in aphasia severity

Several studies have approached the question of sex differences in aphasia severity. Several authors have no found sex differences in aphasia severity,[10,11] whereas other authors have reported that aphasia is less severe in women than in men forms of aphasia than men.[12,13]

Recently Sharma et al.[14] developed an extensive study using 294 patients (172 men, 122 women) taken from the AphasiaBank, a research repository. Sex differences were observed in the severity of aphasia: aphasia was more severe in men than in women. Men exhibited statistically significantly lower Aphasia Quotient (AQ) in the Western Aphasia Battery-Revised (67.4 versus 75.6). This study seems to represent a solid ground to assume that aphasia severity differs between sex and is more severe in men than in women.

## Aphasia types in men and women

Most studies have reported no sex differences in the aphasia types[15,16] Some few studies, however, have reported a different distribution of aphasia types in men and women. Hier et al.,[9] using the NINDS Stroke Data Bank, observed that Wernicke's, global and anomic aphasias were more frequently found in women than men. Gonzalez, Rojas and Ardila[17] observed that Broca's aphasia was more frequent, but less severe in women.

## Aphasia and education

The influence of education on aphasia is unclear. Some few studies have suggested that the educational level can affect the brain organization of language, and hence, aphasia symptomatology. It has been suggested that cerebral representation of language is more ambilateral in illiterate participants than it is in school educated participants, although left cerebral "dominance" for language remains the rule in illiterates.[18,19] Lecours et al.[19] reported some degree of word-finding difficulty and reduction in speech output as well as sizeable production of phonemic paraphasias in right-stroke illiterates. Relationship between education and aphasia typology, however, remains unsettled in the literature.

Lahiri et al.[7] studied the influence of demographic factors (age, gender, bilingualism, and number of years of formal education), lesion-related factors (type of stroke, lesion volume, cortical versus sub-cortical location, and site of lesion), and initial aphasia type were independent variables, on aphasia. It was found that the factors associated with higher initial severity were monolingualism, hemorrhagic stroke, larger lesion volume, cortico-subcortical mixed stroke lesion, and a non-fluent type of aphasia. As per binary logistic regression analysis, independent predictors of higher severity were higher volume of lesion, hemorrhagic stroke, and non-fluent aphasia. It was concluded that the most significant determinants of initial aphasia severity were lesion-related factors and non-fluent aphasia.

González-Fernández et al.[20] **selected** 173 stroke patients and hospitalized controls (n=62) matched for age, education, and socioeconomic status (SES). Percent error on 9 language tasks (auditory and written comprehension, naming [oral, written, and tactile], oral reading, oral spelling, written spelling, and repetition) was analyzed. Education was recorded in years and dichotomized as less than 12 years or 12 years and above for data analysis. The percentage of errors for participants with 12 or more years of education was significantly lower for auditory and written comprehension, written naming, oral reading, oral spelling, and written spelling of fifth grade vocabulary words, even after adjusting for age, sex, stroke volume, and SES. The authors concluded that even once learned, access to written word forms may become less vulnerable to disruption by stroke with increasing years of education.

González et al.[17] found that schooling positively correlated with the Auditory Comprehension subtest of the WAB. The purpose of this study was to analyze the aphasia type distribution in men and women as well as the aphasia severity and its interaction with the educational level. It was hypothesized that aphasia types would have a different distribution in men and women but it the educational level interacted with the sex.

## Methods

### Participants

In this study, participants included patients attended in my private practice. 200 patients, with a single stroke were selected. The following inclusion criteria were used: (1) adult (≥18 years) literate participants with aphasia due to first-ever left hemisphere stroke; (2) conscious (according to WHO definition) at the time of language assessment; and (3) native Spanish speaker. We also used the following exclusion criteria: (1) aphasia caused by intracranial hemorrhage; we did so because intracranial hemorrhages produce an extended effect; (2) pre-morbid psychiatric pathologies; (3) pre-morbid significant cognitive disturbances, congruent with a dementia process; (4) significant non-linguistic cognitive disturbances at the assessment, such as confusion and attentional deficits, impairing the language evaluation.

Handedness was determined based on the direct clinical observation and/or a brief questionnaire answered by a close family member or by the patient him/herself, when it was possible. We received 195 (97.50%) right-handed, and five (2.5%) left-handed participants. In our aphasia sample, there were 119 men and 81 women with a mean age of 57.37 years (SD=15.56).

Our participants had a mean level of education of 13.52 years (SD=4.08) corresponding to approximately high school, according to the Chilean education system. The mean time post onset that they evaluated was in on average 6.58 months (SD=12.94); Time post-onset was at least one month, and hence, patients were in a subacute or chronic stage. All patients had localized brain vascular lesions according to CT o Magnetic Resonance Imaging (RMI). All imaging findings were evaluated by an experienced certified neuroradiologist.

### Language examination

Two different aphasia test batteries were administered: the SWAB-R and SBDAE. The maximum interval between the two tests was one week, initially administering the SBDAE and later the SWAB.

(1) The SWAB-R Part 1 is used to determine the aphasia severity. We only administered four subtests: Spontaneous Speech, Auditory Verbal Comprehension, Repetition, and Naming. An Aphasia Quotient (AQ) was calculated based on these four scores. The AQ was calculated using the following formula: AQ= (Spontaneous speech 20 + Auditory Verbal Comprehension 200/20 + Repetition 100/10 + Naming 100/10) x 2. According to the AQ, aphasia severity is interpreted as follows: 0-25 = very severe, 26-50 = severe, 51-75

= moderate, and 76–above = mild. In our sample, the mean AQ was 59.26 (SD=30.03).

(2) The SBDAE was used in determining the type of aphasia. We preferred to use the SBDAE in determining the aphasia subgroups because it uses not only quantitative but also qualitative classification criteria. In our current study, the distribution of the aphasia types was the following: Global =11 patients (5.50%), Broca=31 (15.50%), Wernicke=30 (15.00%), conduction=22 (11.00%), transcortical sensory=17 (8.50%), transcortical motor =3 (1.50%), and amnesic or anomic = 54 (27.00%), mixed non-fluent =32 (16.00%). Mixed non-fluent Aphasia refers to those patients with a significantly impaired expressive language and auditory comprehension deficits (below 50%). Patients with Broca's aphasia score above 50% in Auditory Comprehension while in Global aphasia Auditory Comprehension falls below 25%.

As observed, the number of patients in each aphasia subtype is quite unequal; this is an implicit limitation not only in this study, but also in similar clinical studies.[6,7] The software IBM SPSS STATISTICS 25 was used. The data was analyzed in two ways. First the clinical characteristics of the different types of aphasia were examined. The impact of the aphasia type distribution in men and women as well as the aphasia severity and its interaction with the educational level was analyzed.

## Results

A significant difference was found in schooling between men and women. Men had a higher schooling in years than women. On the other hand, the age, the time of evolution and the aphasic quotient were not significant differences. The results are in Table 1.

Subsequently, the sample was divided into two groups, one with ≤ 12 years of schooling and the other with ≥ 13 years of schooling. Both groups were compared in relation to the following variables: Age, time of evolution and aphasic quotient. No significant differences were found between the groups with low and high schooling. The results are shown in Table 2.

Next, the total sample was grouped into men and women and in turn each gender was grouped by low and high education in relation to the variables age, time of evolution and aphasic ratio. A qualitative analysis was carried out. The men did not have differences in age, time of evolution and aphasic quotient. The women obtained similar results, in age and time of evolution. On the other hand, in the aphasic quotient there was a greater difference of 8 points in favor of the group with high education. A student's t test was applied, and this difference was not significant. The results are presented in Table 3.

The sample is analyzed by type of aphasia considering gender and schooling. MNF, Wernicke conduction and TM aphasia are more frequent in men than in women. Low schooling is more common in Wernicke's aphasia and Transcortical Motor aphasia. Mixed non-fluent aphasia is more frequent in a group with high schooling. In addition, an X2 (Chi square) was performed. The results obtained were not significant for sex and education. The results are presented in Table 4.

Finally, a comparison is made in relation to sex considering the age, evolution time, schooling and aphasic quotient for the major types of aphasia, which are Mixed non-Fluent, Broca's, Wernicke's and conduction. In patients with Mixed non-Fluent aphasia alone, schooling was significantly higher in men than in women. In Broca's aphasia, the aphasic quotient was significantly better in women than in men. In both Wernicke's and conduction aphasias fluent, there were no significant differences in any of the variables when compared by sex. Table 5 shows the results.

**Table 1** General characteristics of the sample according to the sex

| Aphasia n=200 | Man n=119 (59,5%) | | Women n=81 (40,5%) | | t | p |
|---|---|---|---|---|---|---|
| | $\overline{X}$ | SD | $\overline{X}$ | SD | | |
| Age | 57,68 | 14,19 | 56,91 | 17,45 | 0,343 | 0,733 |
| Time since onset | 7,6 | 15,86 | 5,09 | 6,44 | 1,55 | 0.123 |
| Schooling | 14,12 | 3,89 | 12,63 | 4,2 | 2,57* | 0,011* |
| Aphasia Quotient | 57,05 | 29,72 | 62,5 | 30,38 | -1,26 | 0,209 |

p< 0.001

**Table 2** General characteristics of the sample according to the schooling

| Aphasia n=200 | Schooling ≤ 12 Years n=103 (51.5%) | | Schooling ≥ 13 Years n=97 (48.5%) | | t | p |
|---|---|---|---|---|---|---|
| | $\overline{X}$ | SD | $\overline{X}$ | SD | | |
| Age | 59,6 | 16,17 | 55 | 14,59 | 2,109 | 0,036 |
| Time since onset | 6,12 | 9,69 | 7,07 | 15,71 | -0,514 | 0,608 |
| Aphasia Quotient | 59,48 | 28,57 | 59,02 | 31,66 | 0,11 | 0,913 |

p< 0.001

**Table 3** General characteristics of the whole sample according to the sex and schooling

| Sex | Whole sample | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males | | | | | | Females | | | | | | Total Schooling | | | |
| Schooling | ≤12 Years (55) | | ≥13 Years (64) | | Total (119) | | ≤ 12 Years (48) | | ≥ 13 Years (33) | | Total (81) | | <12 (103) | | ≥13 (97) | |
| Mean / SD | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* | $\overline{X}$ | *SD* |
| Age | 59,62 | 14,73 | 56,02 | 13,60 | 57,68 | 14,19 | 59,58 | 17,83 | 53,03 | 16,38 | 56,91 | 17,45 | 59,60 | 16,17 | 55,00 | 14,59 |
| Time since onset | 6,85 | 11,98 | 8,25 | 18,64 | 7,60 | 15,86 | 5,30 | 6,15 | 4,78 | 6,93 | 5,09 | 6,44 | 6,12 | 9,69 | 7,07 | 15,71 |
| Aphasia Quotient | 59,66 | 27,53 | 54,81 | 31,53 | 57,05 | 29,72 | 59,28 | 30,01 | 67,18 | 30,76 | 62,50 | 30,38 | 59,48 | 28,57 | 59,02 | 31,66 |

**Table 4** General characteristics of the Aphasia types according to the sex and schooling

| Aphasias n=200 | Amnesic 54 | Mixed Non-fluent 32 | Broca 31 | Wernicke 30 | Conduction 22 | Trancortical Sensorial 17 | Global 11 | Transcortical Motor 3 | All |
|---|---|---|---|---|---|---|---|---|---|
| Man | 31 (57,40%) | 20 (62,50%) | 15 (48,38%) | 19 (63,33%) | 16 (72,73%) | 10 (58,82%) | 6 (54,55%) | 2 (66,66%) | 119 |
| Women | 23 (42,60%) | 12 (37,50%) | 16 (51,62%) | 11 (36,67%) | 6 (27,27%) | 7 (41,18%) | 5 (45,45%) | 1 (33,33%) | 81 |
| Schooling ≤ 12 Years | 28 (51,85%) | 13 (40,62%) | 16 (51,62%) | 19 (63,33%) | 12 (54,55%) | 7 (41,18%) | 6 (54,55%) | 2 (66,66%) | 103 |
| Schooling ≥ 13 Years | 26 (48,15%) | 19 (59,38%) | 15 (48,38%) | 11 (36,67%) | 10 (45,45%) | 10 (58,82%) | 5 (45,45%) | 1 (33,33%) | 97 |

**Table 5** Comparation of the major types of Aphasia according to sex and other demographic variables

| **Aphasia Mixed Non-fluent (32)** | **Man (n=20)** | | **Women (n=12)** | | **t** | **p** |
|---|---|---|---|---|---|---|
| | $\overline{X}$ | **SD** | $\overline{X}$ | **SD** | | |
| Age | 59,00 | 16,03 | 48,17 | 13,11 | 1,97 | 0,058 |
| Time since onset | 9,56 | 11,16 | 7,13 | 4,76 | 0,71 | 0,482 |
| Schooling | 15,90 | 3,60 | 11,92 | 3,45 | 3,07 | 0,004* |
| Aphasia Quotient | 21,76 | 10,67 | 26,69 | 17,87 | -0,98 | 0,334 |
| **Aphasia Broca (31)** | Man (n=15) | | Women (n=16) | | t | p |
| | $\overline{X}$ | SD | $\overline{X}$ | SD | | |
| Age | 58,60 | 18,77 | 53,12 | 15,01 | 0,901 | 0,375 |
| Time since onset | 10,44 | 30,44 | 7,18 | 10,56 | 0,404 | 0,689 |
| Schooling | 13,53 | 3,89 | 13,94 | 3,19 | -0,322 | 0,750 |
| Aphasia Quotient | 55,93 | 22,58 | 77,39 | 21,25 | -2,726 | 0,011* |
| **Aphasia Wernicke (30)** | Man (n=19) | | Women (n=11) | | t | p |
| | $\overline{X}$ | SD | $\overline{X}$ | SD | | |
| Age | 59,32 | 15,46 | 65,45 | 15,64 | -1,042 | 0,306 |
| Time since onset | 7,68 | 15,61 | 5,27 | 7,25 | 0,480 | 0,635 |
| Schooling | 13,05 | 4,24 | 10,64 | 4,84 | 1,425 | 0,165 |
| Aphasia Quotient | 48,53 | 17,21 | 46,63 | 21,14 | 0,268 | 0,791 |
| **Aphasia Conduction (22)** | Man (n=16) | | Women (n=6) | | t | p |
| | $\overline{X}$ | SD | $\overline{X}$ | SD | | |
| Age | 50,00 | 13,80 | 59,50 | 24,90 | -1,150 | 0,264 |
| Time since onset | 8,42 | 11,50 | 2,00 | 1,55 | 1,343 | 0,194 |
| Schooling | 13,25 | 3,99 | 14,67 | 2,94 | -0,790 | 0,439 |
| Aphasia Quotient | 71,92 | 14,09 | 68,67 | 13,45 | 0,487 | 0,630 |

*p<0,05

## Discussion

Strokes are more frequent in men and when they occur in women, they are more severe.[21] In this investigation, aphasia was more frequent in men (n = 119) than in women (n = 81). Our findings are similar to those obtained by De Renzi et al.[1] However, Wallentin[4] in a meta-analysis found no significant differences between men and women when age was corrected. It is important to highlight that in our study there were no significant differences in age between both genders.

We found that aphasia was less severe in women than in men. This difference was not significant. These encounters are in agreement with Wallentin,[22] who in a recent article says that there are no significant differences in relation to the severity of aphasia between both sexes. In general, the literature reports that there are no differences between men and women.[10] In contrast, other studies say that women have less severe aphasia.[12] These differences could be a consequence of the fact that women have a bilateral representation of language. This will be discussed later.

On the other hand, in relation to the types of aphasia and sex, we found that transcortical motor, mixed non-fluent and Wernicke aphasias were more frequent in men than in women above 60%. Women in relation to the other aphasias do not show important differences beyond 60%. On the other hand, schooling is different only in Wernicke's aphasia and transcortical motor aphasia in favor of men; In the other types of aphasia, no differences of more than 60% were found.

The findings in the main types of aphasia with respect to sex and other variables showed significant differences in mixed non-fluent aphasia in relation to education. What we had previously observed, men have more years of education than women. The severity of Broca's aphasia was significantly different. Women performed better on the aphasic quotient than men. The differences in the severity of aphasia could be the consequence that women, having less education than men in our study, tend to have language represented bilaterally or with a more relevant participation in language processing by of the right hemisphere. On the other hand, men, having more years of schooling tend to lateralize the language more to the left. Therefore, this would make aphasias more severe in men.[18,23]

It has been suggested that crossed aphasias, that is, those caused by injury to the right hemisphere in right-handed subjects, are more frequent in illiterates.[7] Wernicke's aphasia does not show differences between the two sexes. and finally, conduction aphasia presented a

difference in evolution time. Men had a longer evolution time than women. This could be a consequence of women consulting before men. Finally, aphasia in these four types, which reached a total of 115 patients, was more frequent in men (n = 70) than in women (n = 45), maintaining this difference that we observed in the total sample.

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## Conflicts of interest

The authors declare no conflicts of interest.

## References

1. De Renzi E, FagIioni P, Ferrari P. The influence of sex and age on the incidence and type of aphasia. *Cortex*. 1980;1:627–630.
2. Appelros P, Stegmayr B, Terént A. Sex differences in stroke epidemiology: a systematic review. *Stroke.* 2009;40(4):1082–1090.
3. Benjamin EJ, Muntner P, Alonso A, et al. Heart disease and stroke Statistics–2019 update a report from the American Heart Association. *Circulation*. 2019;139(10).
4. Wallentin M. Sex differences in post–stroke aphasia rates are caused by age. A meta–analysis and database query. *PloS one*. 2018;13(12):e0209571.
5. Ellis C, Hardy RY, Lindrooth RC, et al. Rate of aphasia among stroke patients discharged from hospitals in the United States. *Aphasiology*. 2018;32(9):1075–1086.
6. Pedersen PM, Vinter K, Olsen TS. Aphasia after stroke: type, severity and prognosis. *Cerebrovasc Dis.* 2004;17(1):35–43.
7. Lahiri D, Dubey S, Ardila A, et al. Incidence and types of aphasia after first–ever acute stroke in Bengali speakers: age, gender, and educational effect on the type of aphasia. *Aphasiology.* 2019;1–14.
8. González F, Lavados P, Olavarría V. Incidencia poblacional, características epidemiológicas y desenlace funcional de pacientes con ataque cerebrovascular isquémico y afasia. *Rev Med Chile.* 2017;(145):194–200.
9. Hier DB, Yoon WB, Mohr JP, et al. Gender and aphasia in the stroke data bank. *Brain Lang.* 1994;47(1):155–167.
10. Engelter ST, Gostynski M, Papa S, et al. Epidemiology of aphasia attributable to first ischemic stroke: incidence, severity, fluency, etiology, and thrombolysis. *Stroke*. 2006;37(6):1379–1384.
11. Sarno MT, Buonaguro A, Levita E. Gender and recovery from aphasia after stroke. *J Nerv Ment Dis.* 1985;173(10):605–609.
12. Basso A, Capitani E, Moraschini S. Sex differences in recovery from aphasia. *Cortex*. 1982;8(3):469–475.
13. Chen Y, Li Y. The effect of gender on the post-stroke aphasia. *Journal of Shanghai Jiaotong University (Medical Science)*. 2009;29(8):978–981.
14. Sharma S, Briley PM, Wright HH, et al. Gender differences in aphasia outcomes: evidence from the AphasiaBank. *International Journal of Language & Communication Disorders.* 2019;54(5):806–813.
15. Code C. Rowley D. Age and aphasia type: The interaction of sex, time since onset and handedness. *Aphasiology.* 1987;(4):339–345.
16. Scarpa M, Colombo A, Sorgato P, et al. The incidence of aphasia and global aphasia in left brain–damaged patients. *Cortex.* 1987;23(2):331–336.
17. González R, Rojas M, Ardila A. Post–stroke Aphasia in Spanish language: the effect of demographic variables. *Aphasiology*. 2020;1–11.
18. Coppens P, Parente MA, Lecours AR. Aphasia in illiterate individuals. In: Coppens P, Lebrun Y, Basso A, editors. Aphasia in atypical populations. Routledge. 1998. pp. 175–20.
19. Lecours A, Mehler J, Parente MA, et al. Illiteracy and brain damage –1. Aphasia testing in culturally contrasted populations (control subjects. *Neuropsychologia*. 1987;25(1):231–245.
20. González–Fernández M, Davis C, Molitoris JJ, et al. Formal education, socioeconomic status, and the severity of aphasia after stroke. *Arc Phys Med Rehab.* 2011;92(11):1809–1813.
21. Appelros P, Asberg S. Sex differences in stroke. *Handbook of Clinical Neurology.* 2020;175:299–312.
22. Wallentin M. Gender differences in language are small but matter for disorders. *Handb Clin Neurol.* 2020;175:81–102.
23. Rivera D. Morlett A, Arango JC. Neuropsicología y analfabetismo. In: Manual Moderno, editor. Ciudad de Mexico. 2019.