ORIGINAL ARTICLE

SARS-CoV-2 and language skills: a comparison study in young adults

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ABSTRACT

Objective: To analyze the influence of SARS-CoV-2 on the language of young adults. **Method: This** study was carried out with individuals of both sexes, aged between 18 and 35 years. Forty--seven individuals took part in the study, divided into two groups: Control Group (CG), without a diagnosis of COVID-19 and Study Group (SG), with a diagnosis of COVID-19. They all underwent anamnesis, meatoscopy, pure tone audiometry, acoustic immittance measurements and the Brief Neuropsychological Assessment Instrument - NEUPSILIN. The *Mann-Whitney U* test was used to statistically analyze the data. **Results:** Significant differences were observed in total language ability between the groups, in the oral language task (conversational difficulties) and in the inference processing subtask (comprehension of the spoken message). **Conclusion:** SARS-CoV-2 infection had a negative impact on language.

Keywords: Language, COVID-19, Cognition, Adults, Pandemic.

INTRODUCTION

Typical language development involves a gradual process of acquisitions, which are based on the maturation of the Central Nervous System (CNS). The maturation of this aspect is closely related to the wide range of experiences, showing a remarkable capacity for plastic changes, which will influence behavioral results throughout life[1] . Therefore, taking into account the numerous sequelae resulting from SARS-CoV-2, when suffering the influence of a virus that causes changes directly in the CNS, there is a possibility that damage may occur to this process in development or when it is already established.

The consequences of COVID-19 are already evident, and it was recently named by the World Health Organization (WHO) as the Long Covid Syndrome, which is defined as the condition in which individuals have sequelae that last for several weeks or months after the onset of viral infection[2,3] .

SARS-CoV-2, being a respiratory coronavirus, reaches the lower airway, often causing lung lesions[3] . However, it has a complex pathophysiology, involving a hyperimmune response and coagulopathy, which is supposedly related to diverse and prolonged manifestations, leading to the involvement of multiple systems and organs of the human body . [3-4]

In this perspective, it is known that several central lesions are due to the infection, which often causes significant impacts of COVID-19 on language, which may be associated with cognitive-based impairments, as well as in its development, due to non-pharmacological measures to contain the spread of the virus, related to language development in children[5-4-6] .

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SARS-CoV-2 is believed to invade the CNS from the peripheral nerve terminals via neural pathways, such as the olfactory nerves[6] . Thus, it can cause cognitive impacts, such as inattention, impairments in executive function and memory, of which recent studies have already demonstrated such aspects in diagnosed individuals[4] .

In view of this cognitive influence, since there is an interrelationship between language and cognition, there is a need to investigate the oral and written language of these individuals, especially in the adult and highly educated population. In addition, this research is justified by the contributions to the specialized literature on the language sequelae caused by the virus, in a population without neurological and developmental influences, seeking to measure the real performance of these participants. With this, the hypothesis would be related to possible language impairments in the population affected by SARS-CoV-2, demonstrating the possible need for therapeutic intervention for this, seeking to restore individuals' complaints, as well as improving their quality of life.

Therefore, the aim of this study was to analyze the influence of SARS-CoV-2 on the language of young adults.

METHOD

Study design

This is a descriptive and quantitative study, approved by the Research Ethics Committee of the Federal University of Santa Maria under the number 56038322100005346. The Free and Informed Consent Form (FICF) was signed by all the participants in the study, in order to clarify the risks and benefits of their participation.

The following eligibility criteria were listed: individuals of both sexes, aged between 18 and 35 years, educated (with higher education completed or in progress - equal to or greater than 12 years of schooling), speakers of Brazilian Portuguese, right hand preference, hearing thresholds within the normal range[7] , middle ear integrity and contralateral stapedial acoustic reflexes present bilaterally. In addition, no obvious or diagnosed neurological or psychiatric impairment, with or without a diagnosis of COVID-19, proven by presenting the RT-PCR test.

Participants

The sample was carried out by convenience, and 68 individuals were seen at the audiology outpatient clinic of a school clinic, who were recruited by publicizing the study on the social networks of the school clinic and the researchers. Of these, 47 individuals met the criteria for the sample, of which 36 were female and 11 male, matched for age, gender and schooling.

The participants were divided into two groups: Control Group (CG), made up of 25 individuals (6 males and 19 females), aged between 19 and 29 years (average: 22.24 years) without a diagnosis of COVID-19 and Study Group (SG), made up of 22 individuals (5 males and 17 females), aged between 19 and 28 years (average: 22.82 years), with a diagnosis of COVID-19.

With regard to the SG, it is worth noting that none of the subjects were hospitalized, and they were diagnosed with the infection using the RT-PCR. Of the partici-

pants, it took between 2 months and 1 year and 7 months (average 1 year and 2 months) from the diagnosis of infection to the completion of the procedures. Three had reinfection (twice). Furthermore, these subjects had no complaints related to pre-infection cognitive aspects.

The sample calculation was carried out using GPower software version 3.1. The following parameters were used for the calculation: effect size of 0.5, significance of 0.05 and power of 0.8. In the end, 28 individuals had to be collected, and this figure was subdivided into two groups, each with 14 subjects. The same was done to measure the number of participants needed. As a result, the sample proved to be sufficient for this study in both groups, as the sample size was higher than stipulated.

Methodological design

For a better understanding of the methodology, the procedures were divided into: sample composition procedures and research procedures.

Data collection procedures

Semi-structured questionnaire: All subjects filled in an online questionnaire with their identification data, questions about hearing aspects, audiological complaints about speech understanding, cognitive aspects and general health.

Visual inspection of the external acoustic meatus: A visual inspection of the acoustic meatus was carried out using a *Mikatos* model TK otoscope, in order to ascertain the necessary conditions for the examination, as well as the possible need for referral to an otorhinolaryngologist.

Pure tone audiometry: carried out in an acoustically treated booth, using TDH-39 headphones and an *Interacoustics* AD229 audiometer. Hearing thresholds were considered to be within normal limits when the thresholds for the frequencies conventionally assessed (250Hz to 8000Hz), by air conduction, were above 20 dBHL[7] .

Logoaudiometry: The assessment comprised two stages, with the Speech Recognition Threshold (SRT) being carried out. Individuals were considered to be at their threshold when they got 50% of the four presentations right. Subsequently, the Speech Recognition Percentage Index (SRPI) was performed. The subjects were presented with 25 words. In this way, the number of errors was reduced from a total of 100%[8] . The same audiometer was used as for pure tone audiometry.

Acoustic immittance measurements: carried out using an *Interacoustics* AT235 device and a TDH-39 earphone. The tympanometric curves were classified using the criteria proposed by Jerger, Jerger and Mauldin (1972) and the stapedial reflexes were classified using the criteria of Jerger and Jerger (1989). Participants had to have type A tympanometric curves and contralateral acoustic reflexes present at normal levels bilaterally.

Research procedure

The Brief Neuropsychological Assessment Instrument (NEUPSILIN) was used to assess cognitive language skills. This is a clinical tool that enables a comprehensive description of the main components of

cognitive skills across different age groups. It can be applied to individuals aged 12 to 90 (from adolescence to senescence), with at least one year of schooling. Thus, its use is justified because it is an instrument that has greater methodological rigor and has been exposed to psychometric studies, so it has evidence of validity[9] .

NEUPSILIN is made up of 32 tasks that aim to characterize a brief cognitive profile by identifying the preservation or impairment of neuropsychological abilities through eight main cognitive functions: temporal-spatial orientation, concentrated auditory attention, visual perception, memory, arithmetic skills, language, praxis and executive functions.

As the focus of the study was to analyze language ability, the data analysis used language tasks, which are subdivided into oral language (naming, repetition, automatic language, comprehension and inference processing) and written language (reading aloud, reading comprehension, copied writing and dictated writing), making it possible to analyze total language performance (oral and written language).

The final score was calculated using the total score for total language ability (sum of the scores for oral language and written language). For the oral and written language tasks, total scores were used, based on the sum of each subtask within the types of languages assessed. The same was done for the subtasks. It should be noted that the higher the score, the better the participant's language performance.

Data analysis

In the statistical analysis, the variables were analyzed for normality using the *Shapiro-Wilk test* and then the *Mann-Whitney* U-test was used to compare the groups, with a significance value of p-value < 0.05.

RESULTS

Case analysis

It can be seen in figure 1 that the groups studied in the study have proximal n, but one of the limitations of the research is that the study group has more women than men, making it difficult to generalize the data, despite not showing statistically significant differences.

Table 1. Analysis of the variables gender, age and schooling between the two groups.

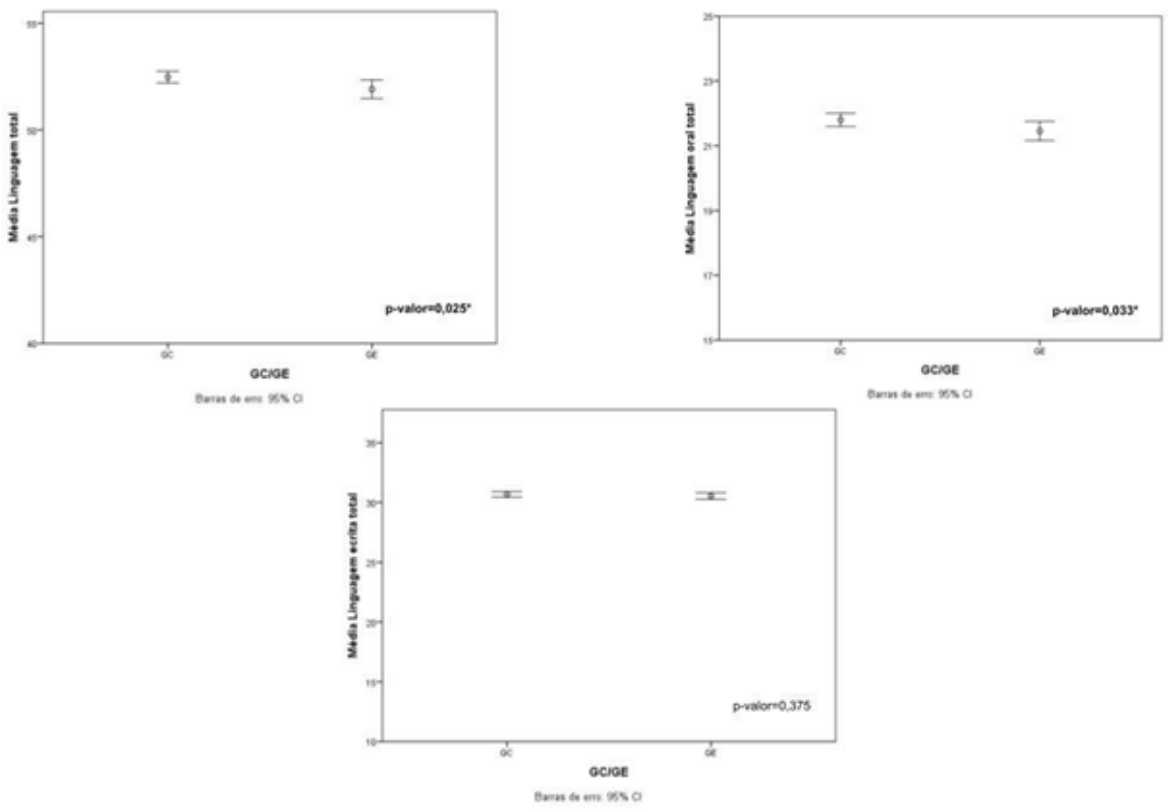
VARIABLES	GROUP	N	AVERAGE	DP	P-VALUE
SEX	GC	25	11M - 6H	-	0,919
	GE	22	17M - 5H	-	
AGE	GC	25	22,24	-	0,432
	GE	22	22,82	-	
SCHOOLING	GC	25	15,4	-	0,360
	GE	22	15,64	-	

Legend: GC= Control Group; GE= Study Group; M: Women; H: Men.

Data analysis

Figure 1 shows the comparison for total language, total oral language and total written language (sum of each subtask within language) between the groups.

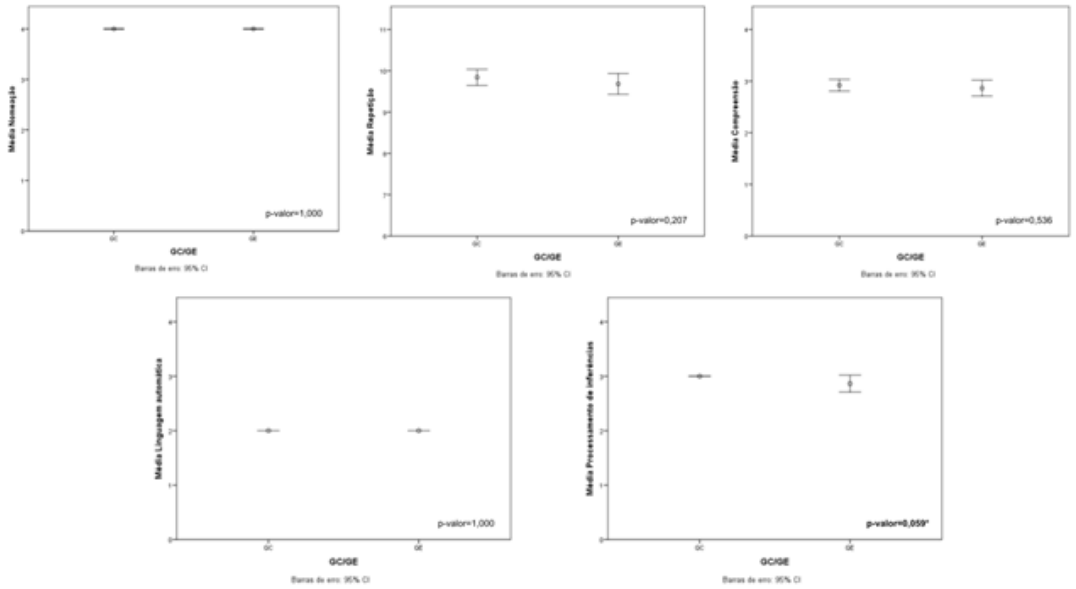
Figure 1. Comparison between the scores for total language, total oral language and total written language between the groups.



Caption: CG = Control Group; SG = Study Group.

Figure 2 shows the comparison between the groups for the oral language subtasks (Figure 3).

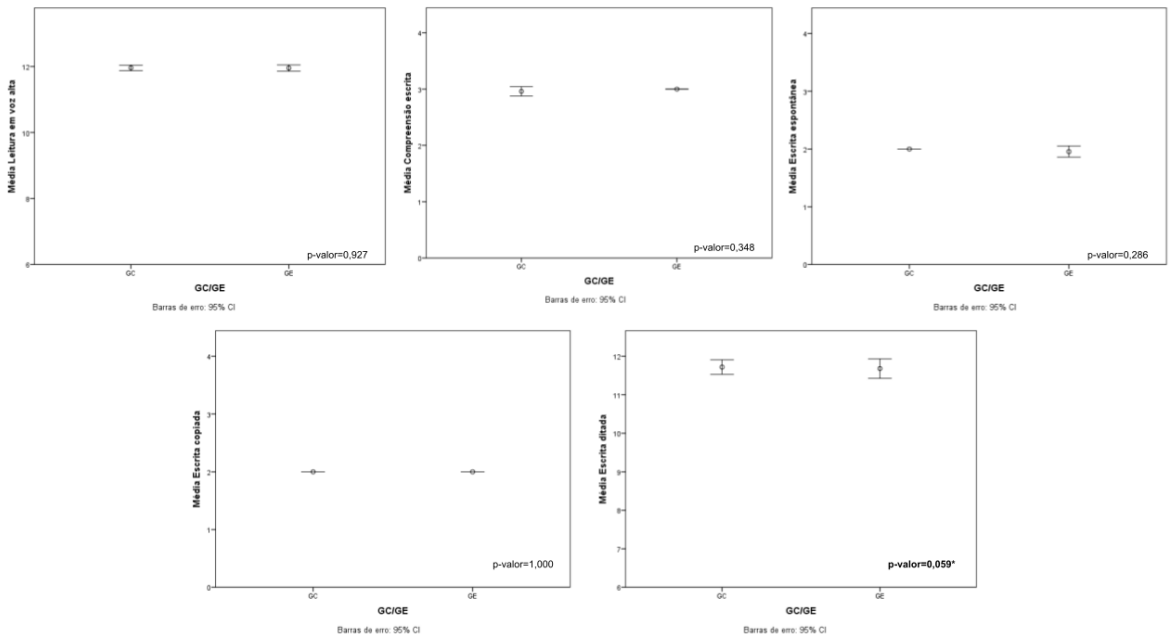
Figure 2. Comparison of oral language subtasks between groups.



Caption: CG = Control Group; SG = Study Group.

Figure 3 shows the comparison for written language subtasks between the groups (Figure 3).

Figure 3: Comparison of the subtasks for written language between the groups.



Caption: CG = Control Group; SG = Study Group.

DISCUSSION

The findings of this study are in line with the hypothesis that the SARS-CoV-2 agent changes CNS functioning, impacting on language issues. Thus, it contributes to the specialized literature, due to the lack of research that aimed to find the findings exposed here, in view of the various manifestations arising from COVID-19, due to the pathophysiology and consequences of viral infection, which cause functional losses[4-3] .

It should be emphasized that investigating language aspects in young adults, without neurological alterations, but with a high level of education, is of great importance for the speech therapy clinic, since individuals with SARS-CoV-2 can present cognitive, neuropsychiatric and communication alterations in the short, medium and long term, which can affect their language performance, negatively impacting their quality of life.

Language is the skill most used by individuals, whether during development, adulthood or senescence, since communication is the main social medium used by individuals. In this way, it is a complex skill that requires intact and interconnected brain functioning, as well as various other cognitive and auditory functions, to make it possible to appropriate and transmit thoughts and ideas with intentionality[1] .

Communication, then, is a process involving a receiver and a sender, i.e. one person sends a message and the other receives and interprets it, in order to respond with cohesion and coherence[10] . In this sense, based on the complex functioning for adequate language, the total performance in this study is justified, because if there are impairments in some of the language tasks, this is manifested in the lower overall performance.

In the present study, when comparing the overall language performance of participants without and with SARS-CoV-2 infection, individuals who had COVID-19 had lower scores, with statistically significant differences. In this sense, such findings are justified due to the brain areas affected and, consequently, the cognitive domains affected, for example, memory[5-11] . Studies suggest that the hippocampus seems to be a key region which, when affected, can contribute to cognitive deficits. Therefore, in the event of a process that compromises its integrity, there may be consequences such as memory difficulties[12] , which are related to language, based on the complex mechanism involved, justifying the lower scores found.

The language process requires memory, since its basic function is to organize thought in a systematized way, so that content can be retained, remembered and reproduced[13] . It is therefore necessary to understand or produce oral messages[14] . This is in line with the significant differences in the oral language task between the participants without and with SARS-CoV-2 infection, showing difficulties in conversation and understanding the spoken message, characteristic of the changes that occur at a central level, which are manifested in lower functional performance.

Language still requires information to be kept in memory, as memory is strongly intertwined with spoken language processing[15] . This fact is linked to the finding in the subtask of processing inferences, due to the lower scores for the SG, demonstrating difficulties in processing and cognitively interpreting previous semantic

information. These difficulties have a direct impact on speech comprehension, affecting communication when the message is unclear. Thus, individuals with COVID-19 may have difficulties in interpreting and understanding a linguistic unit, mainly related to the text or discourse, due to difficulties in applying their own knowledge to the explicit information in the message.

With regard to the written language subtasks, no statistically significant differences were found. This is because in tasks such as reading aloud and reading comprehension, the literature shows that reading problems occur due to decoding difficulties and not comprehension difficulties[16] . These findings are justified by the fact that COVID-19 manifests itself mainly in the processing of spoken messages. It is also due to the high level of schooling and cognitive stimulation of the individuals, given that they are exposed to reading tasks on a daily basis.

Based on these findings, young, highly educated adults with COVID-19 appear to have complications, especially in understanding spoken messages, which tend to have an impact on communication. These findings are justified by the fact that the changes that occur at a central level manifest as symptoms in the long-term functional capacity of language, even without neurological complications[17-18-19] .

Therefore, the results presented here show that although SARS-CoV-2 infection has a significant impact on language and, consequently, on quality of life, it is not always diagnosed in a timely manner. These findings reflect possible underdiagnosis and neglect, which demonstrate the need to include assessments and strategies in clinical practice, with the aim of stimulating the changes found, helping and minimizing the impacts caused by COVID-19, given the importance of language for communication.

Limitations of the study

It is important to emphasize the need for imaging tests as a complementary assessment of language aspects, in order to ratify the findings, seeking to observe brain function in different activities.

CONCLUSION

SARS-CoV-2 infection has had a negative impact on language, with significant impairments in oral language, mainly related to the subtask of processing inferences.

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