

Language Disorders in People with Cognitive Impairment: A Cross-sectional Study

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ABSTRACT

Introduction: The progressive ageing of the population has generated significant interest in various areas, particularly Cognitive Impairment (CI). It is necessary to know the specific characteristics of people with cognitive development to establish the basis for the intervention.

Aim: To understand the relationship between the cognitive deterioration process and language characteristics, aiming to determine whether linguistic alteration could be considered a symptom of cognitive deterioration.

Materials and Methods: This study employed a cross-sectional design involving two groups: 17 individuals aged over 70 years, consisting of eight with CI and nine without CI. Participants were assessed using the Mini-Mental State Examination (MMSE).

Language abilities were evaluated using the Boston Naming Test and the Verbal Fluency Test in separate individual sessions. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) program.

Results: The results indicated that individuals with CI exhibited poorer performance in language tests, particularly in areas related to productive and comprehensive lexical and semantic development. These differences were statistically significant across all assessed domains (p -value<0.001).

Conclusion: CI is accompanied by significant impairment in language skills, which could be considered an indicator of cognitive decline. Therefore, specific interventions targeting language abilities are warranted throughout the progression of CI.

INTRODUCTION

According to Winblad B et al., CI refers to a partial or total alteration of intellectual functions [1]. Clinical manifestations begin with natural ageing, age-related memory impairment, mild CI, and progress to mild, moderate, and severe dementia, where there is a complete loss of all abilities [2]. One of the primary manifestations experienced by individuals with CI is brain deterioration, which directly affects communication. This condition is referred to as "Cognitive Communication Disorders" [3]. The percentage of individuals presenting CI is directly proportional to age, with a 15-20% prevalence among individuals over 60 years of age [4].

The initial linguistic alterations observed in CI primarily occur at the lexical-semantic level [5], giving rise to one of the most characteristic features of this condition: lexical anomias. Lexical anomias are defined as the inability to access and retrieve lexical units and their corresponding conceptual bases [6]. This difficulty in lexical access often manifests as the "tip of the tongue" phenomenon [7], characterised by a strong sensation of familiarity alongside an inability to recall a known lexical item, which might eventually be recalled with sufficient attention and encoding feedback [8]. Individuals with CI often attempt to compensate for this difficulty through phonological substitutions, semantic paraphasias, anomalous word repetitions, and circumlocutions, using words that replace the intended meaning of those they cannot retrieve [9]. Moreover, research has consistently shown that individuals with CI exhibit significant limitations in their ability to recall information related to objects, people, and places [10]. Additionally, concerning verbal fluency tasks, individuals with CI demonstrate greater impairment in semantic fluency tasks compared to phonological fluency tasks, underscoring difficulties in naming and lexical access [11].

Furthermore, researchers such as Vuorinen E et al., among others, have provided evidence that individuals with CI exhibit non specific speech patterns characterised by fewer elements of content, deictics, indefinite terms, pronouns, and repetitions compared to

individuals without CI [12]. Additionally, individuals with CI tend to use fewer content-rich phrases [13] and may employ inappropriate or redundant grammatical constructions [14]. Murray LL examined speech deviations to assess information efficiency and concluded that individuals with CI display more false starts, vague vocabulary, and paraphasias than those experiencing normal ageing [15]. Similarly, Chapman SB et al., and Bayles KA et al., identified difficulties in discursive coherence [16,17]. Concerning syntax, it is hypothesised that limitations in working memory or semantics can impact the ability to utilise elaborate and complex grammatical constructions [18]. However, Ripich DN et al., contend that there is no difference in the mean length of verbal output between healthy adults and individuals with CI [19]. Consequently, it appears that the only dimension of language preserved in CI is phonology, both expressive and receptive [20].

The significance and novelty of the research presented below stem from the importance of gaining further insights into the linguistic profile to establish intervention programs that are optimally tailored to the characteristics exhibited by individuals with CI. Hence, given the linguistic disorders previously described that link cognitive deterioration with the emergence of linguistic challenges, the objective of this study was to ascertain the linguistic impairments in individuals with CI. The initial hypothesis posits that individuals with CI experience more language difficulties than those without CI.

MATERIALS AND METHODS

This research was conducted using a cross-sectional methodology at a specific care centre in Spain for individuals with cognitive disorders between January and June 2022. The study received prior approval from the respective bioethics committee of the Faculty of Health Sciences at the University of Castilla-La Mancha (28/2022).

Inclusion criteria: Participants aged over 65 years, regularly attending the SEPAP resource (Service for the Promotion of

Personal Autonomy) classified as grade 1 or moderate dependency were included in the study.

Exclusion criteria: Participants with severe CI (as assessed by a specialist doctor), severe vision and/or hearing impairments, and characteristics of illiteracy were excluded from the study.

For the subsequent analysis of the obtained results, a quantitative methodology was employed, which will be described in the corresponding section.

Participants: This study involved 17 individuals aged between 72 and 89 years from a SEPAP for individuals classified as grade 1 or moderate dependency. This situation appears when the person needs support at least once a day to carry out certain basic activities of daily living (bathing, eating, shopping, etc.) or needs intermittent or limited support for personal autonomy. This classification was carried out according to the dependency law of Talavera de la Reina (as determined by the city's dependency team). These individuals were initially diagnosed with various pathologies such as Parkinson's disease, Pick's disease, and early Alzheimer's disease. The sample size was limited by the number of individuals who agreed to participate in the study. CI was assessed using the MMSE, which was administered by a psychologist. Following the evaluation to determine the presence of CI, two distinct groups were identified.

Process: Initially, the research team contacted the AFATA association (Association of Relatives of Alzheimer's and Other Dementia Patients of Talavera) to arrange a meeting. During this meeting, the clinical profiles of individuals with various levels of CI were discussed. Subsequently, the research team redirected interested individuals to the SEPAP resource.

For individuals who agreed to participate in the study, informed consent was obtained, along with a commitment to confidentiality to ensure the privacy of user data. Following the signing of both documents, the evaluation commenced, conducted individually over three sessions. All procedures in this study adhered to ethical standards and the Declaration of Helsinki of 1975. Additionally, all participants provided their informed consent for the study.

During the first session, CI was assessed using the MMSE test [21] to differentiate between two groups (with CI/without CI), with each session lasting approximately 10 minutes. In the second session, image naming ability was evaluated using the Boston Naming Test [22], with a duration of 30-40 minutes. Finally, the third session involved assessing verbal fluency using the Verbal Fluency Test [23], which lasted approximately 10-15 minutes. Initially, the MMSE test [21] was administered. This cognitive screening evaluates suspected symptoms compatible with CI by exploring areas such as temporal orientation, spatial orientation, attention, calculation, memory, naming, repetition, comprehension, reading, writing, and drawing. Scores on this test range from 0 to 30 points, with scores below 23 points indicating CI [24].

Secondly, the Boston Naming Test [22] was utilised to assess naming ability by presenting 60 images. This test provides various aids to facilitate naming in cases of difficulty, including semantic cues (information about the object's utility), phonemic cues (pronunciation of the initial word sounds), and multiple-choice options (four choices provided, one of which is correct). One point is awarded for each correct answer, with a maximum score of 60. The answers given with semantic and phonetic keys were noted [25].

Lastly, the Verbal Fluency Test [23] was employed to evaluate verbal productivity, semantic memory, language, and executive function. This test is considered a sensitive measure of CI. Participants are asked to generate as many words as possible in one minute across various tasks: semantic fluency (e.g., animals, fruits/vegetables, and kitchen utensils), phonological fluency (e.g., words beginning with /P/, /M/, and /R/), and excluded letter fluency (e.g., words without the letters /A/, /E/, and /S/) [26].

STATISTICAL ANALYSIS

To analyse the data obtained from this investigation, the statistical software SPSS 24.0 was utilised to generate descriptive results. For comparing both groups, the independent samples t-test was employed to determine whether significant differences existed between individuals with and without CI. Subsequently, the results were further examined using the Pearson Correlation Index to observe potential relationships between the variables studied.

RESULTS

The group of individuals with CI consisted of eight participants 80.87 ± 4.1 years, aged between 75 and 85 years, comprising five women and three men. The group of individuals without CI comprised nine participants: seven women and two men, with a mean age 77.77 ± 2.13 years.

In the MMSE, the group of individuals with CI achieved an average score of 22.25 ± 1.75 , indicative of CI. Conversely, individuals without CI obtained an average score of 29 ± 1.0 , indicating the absence of CI. Regarding the scores obtained in the Boston Naming Test, it was evident that the group of individuals with CI attained significantly lower (p-value < 0.001) average scores compared to those without CI. Subsequently, the data from the Verbal Fluency Test were analysed, revealing significant differences between the two groups. In the semantic fluency subtest, individuals with CI obtained an average score of 30.25 ± 4.23 , whereas those without CI achieved a score of 41 ± 6.18 . For the phonological fluency subtest, individuals with CI scored 20.88 ± 5.62 points, while those without CI scored 29.33 ± 6.93 . Notably, the greatest differences were observed in the semantic fluency subtest, although significantly lower scores were evident for individuals with CI across all subtests compared to those without CI (p-value < 0.05) [Table/Fig-1].

| Tests | With CI | Without CI | p-value |
|--------------------------------------|------------------|-------------------|-----------|
| Mini-Mental State Examination (MMSE) | 22.25 ± 1.75 | 29.0 ± 1.0 | < 0.001 |
| Boston Naming test | 33.38 ± 4.24 | 43.89 ± 4.68 | < 0.001 |
| Semantic fluency | 30.25 ± 4.23 | 41.0 ± 6.18 | < 0.001 |
| Phonological fluency | 20.88 ± 5.62 | 29.33 ± 6.93 | 0.034 |
| Excluded letters fluency | 14.88 ± 4.61 | 21.33 ± 3.70 | < 0.001 |
| Total number of words generated | 66 ± 12.14 | 91.66 ± 12.42 | < 0.001 |

[Table/Fig-1]: Comparison of median scores for the MMSE and vocabulary test between CI and without CI group.

Regarding the correlation between the different areas evaluated, the results are presented in [Table/Fig-2]. This table indicates that all fluency tasks exhibited correlations with each other. However, concerning the Boston Test, significant correlations were observed only between semantic fluency (r-value = 0.636, p-value < 0.001) and total verbal fluency (r-value = 0.597, p-value < 0.05).

DISCUSSION

As stated in the initial hypotheses, language alterations in individuals with CI can be considered symptoms of this process, and individuals with CI indeed exhibit more language difficulties than those without CI. This association between cognition and language has been well-documented in recent studies [27-30]. The results of present study demonstrate that individuals with CI achieve significantly lower scores in naming and verbal fluency compared to those without CI. These findings align with research conducted by other authors such as Malek-Ahmadi M et al., who have confirmed that language is one of the most affected domains in CI, particularly in the naming of objects and verbal fluency [31].

The results of the naming test are consistent with findings from other studies [4,20], which have indicated that individuals with CI encounter more difficulties in naming compared to those without

| Variables | Semantic fluency | Phonological fluency | Fluency exclusive letters | Total verbal fluency | Boston test |
|----------------------|------------------|----------------------|---------------------------|----------------------|-------------|
| Semantic fluency | 1 | 0.622** | 0.621** | 0.786** | 0.636** |
| Phonological fluency | 0.622** | 1 | 0.691** | 0.518* | 0.330 |
| Fluency lyrics | 0.621** | 0.691** | 1 | 0.800** | 0.417 |
| Total verbal fluency | 0.786** | 0.518* | 0.800** | 1 | 0.597* |
| Boston quiz | 0.636** | 0.330 | 0.417 | 0.597* | 1 |

[Table/Fig-2]: Correlations between the different areas evaluated in the CI group.

**The correlation is significant at the 0.01 level (bilateral). (p<0.001)

*The correlation is significant at the 0.05 level (bilateral). (p<0.05)

CI [32]. Furthermore, consistent with present study, several investigations have demonstrated that providing a phonemic cue after individuals with Alzheimer’s disease struggle to spontaneously name a word significantly aids their performance [33,34].

As confirmed in this research, authors Juncos-Rabadán O et al., and White KK et al., affirm that individuals with Mild Cognitive Impairment (MCI) experience greater difficulty in phonological access compared to older adults without CI, a phenomenon known as the tip of the tongue phenomenon, which contributes to the aforementioned naming difficulties [11,35]. They suggest that this difficulty arises from a decline in the transmission of activation from semantic representations to phonological ones, rendering lexicon access impossible. Other authors, also highlight the challenges in lexical-semantic access, which individuals attempt to compensate for with semantic errors and circumlocutions [36].

The results of the verbal fluency test are consistent with those of other authors, such as [37], who assert that individuals with CI exhibit reduced performance in verbal fluency tests, both phonological and categorical [38]. However, contrary to the findings of this study, it has been demonstrated by different authors [39] that semantic verbal fluency shows significantly greater deficits compared to phonological fluency [40]. This discrepancy can be attributed to the disrupted processes involved; semantic verbal fluency tests necessitate the retrieval of semantic memory content (hierarchically organised concepts and words), while phonological verbal fluency tests involve the exploration of the lexical system and the use of phonological criteria strategies. Venneri A et al., support the hypothesis of early deterioration in semantic memory in Alzheimer’s disease, without evidence of slowing in phonological criteria [41].

It can be asserted that naming tasks, access to the lexicon, and verbal fluency are compromised in individuals with MCI, as these abilities rely on processes that are affected within this cohort [42]. Additionally, significant correlations are observed among these tasks, except in the Boston Naming Test, which only correlates with semantic and total verbal fluency. This may be attributable to the similarity in the processes utilised for these tasks [39].

Limitation(s)

As potential limitations of the study, it should be noted that the sample size could have been larger, and the findings primarily pertain to the Spanish language. However, authors cannot generalise these characteristics to other languages. Therefore, it is imperative to continue this line of research in future studies.

CONCLUSION(S)

The conclusions drawn from this study are manifold. Firstly, it is paramount to underscore that language difficulties serve as characteristic symptoms of CI. Secondly, there is a critical importance in the early assessment of these linguistic abilities, particularly in the domains of naming and verbal fluency, to efficiently and promptly detect MCI and initiate immediate intervention. This is crucial for enhancing quality of life and mitigating progression to more severe stages. Thirdly and finally, it is imperative to emphasise the pivotal role of speech therapists throughout the course of CI, especially during the initial stages. Their involvement aims at enhancing the effectiveness of assessment and facilitating a

comprehensive, multidisciplinary intervention to improve the quality of life for this population.

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