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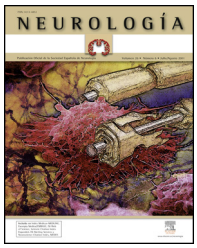

ORIGINAL ARTICLE

Oral reading fluency analysis in patients with Alzheimer disease and asymptomatic control subjects☆

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KEYWORDS
Alzheimer disease;
Speech;
Oral reading;
Fluency;
Speech rate;
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Abstract
Introduction: Many studies highlight that an impaired ability to communicate is one of the key clinical features of Alzheimer disease (AD).
Objective: To study temporal organisation of speech in an oral reading task in patients with AD and in matched healthy controls using a semi-automatic method, and evaluate that method's ability to discriminate between the 2 groups.
Subjects and methods: A test with an oral reading task was administered to 70 subjects, comprising 35 AD patients and 35 controls. Before speech samples were recorded, participants completed a battery of neuropsychological tests. There were no differences between groups with regard to age, sex, or educational level.
Results: All of the study variables showed impairment in the AD group. According to the results, AD patients' oral reading was marked by reduced speech and articulation rates, low effectiveness of phonation time, and increases in the number and proportion of pauses. Signal processing algorithms applied to reading fluency recordings were shown to be capable of differentiating between AD patients and controls with an accuracy of 80% (specificity 74.2%, sensitivity 77.1%) based on speech rate.
Conclusion: Analysis of oral reading fluency may be useful as a tool for the objective study and quantification of speech deficits in AD.

PALABRAS CLAVE
Enfermedad de Alzheimer;
Habla;
Lectura;

Análisis de la fluencia lectora en pacientes con la enfermedad de Alzheimer y controles asintomáticos

Resumen
Introducción: Numerosos estudios han puesto de manifiesto que la alteración en la capacidad comunicativa es uno de los síntomas característicos de la enfermedad de Alzheimer (EA).

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Fluencia;
Velocidad de elocución;
Velocidad de articulación

Objetivo: Estudiar la organización temporal del habla en una tarea de lectura en un grupo de pacientes con EA y otro de controles sanos, utilizando un procedimiento semiautomático, así como valorar su capacidad para discriminar entre ambos grupos.
Sujetos y método: Se aplicó una prueba de lectura a 70 sujetos: 35 con EA y otros tantos controles. Antes del registro del habla, los sujetos fueron sometidos a una batería de pruebas neuropsicológicas. Los grupos no diferían en edad, sexo o nivel de estudios.
Resultados: Todas las variables analizadas se mostraron alteradas en el grupo con EA. Los resultados señalan que la lectura de los pacientes con EA se caracteriza por una reducida velocidad de elocución y articulación, una baja efectividad del tiempo de fonación, así como en un incremento del número y la proporción de las pausas. Los algoritmos de procesamiento de la señal aplicados a las grabaciones de fluidez lectora demostraron su capacidad para discriminar entre ambos grupos con una precisión del 80% (especificidad 74,2%; sensibilidad 77,1%) mediante la velocidad de elocución.
Conclusión: El análisis de la fluidez de lectura oral puede representar una herramienta potencial para el análisis objetivo y la cuantificación de los déficits del lenguaje en la EA.

Potential utility of reading fluency analysis for distinguishing between asymptomatic subjects and patients with Alzheimer disease

Distinguishing early stages of Alzheimer disease (AD) from the cognitive impairment associated with normal ageing is a challenge. Rapid ageing among the population has drawn attention to the need to develop instruments for diagnosing AD by first identifying early (premorbid) markers allowing us to determine the nature, type, and severity of the disease.

Numerous studies have shown that changes in language are some of the most apparent symptoms in AD.[1] They affect between 8% and 10% of the population in early stages of the disease and become more severe in later stages.[2] It is well-documented that patients with AD show signs of language deficit long before their diagnosis is confirmed,[3,4] and this tendency is especially useful for detecting mild cognitive decline.[5] The meta-analysis performed by Bäckman et al.[6] concludes that language decline shows a significant effect size for cognitive decline in preclinical patients with AD, years before the clinical diagnosis has been established. Both semantic verbal fluency (SVF) and phonological verbal fluency (PVF) tests are widely used in diagnosing AD, and they are considered reliable indicators of language deterioration[7] in early detection of both AD and mild cognitive impairment (MCI).[8]

Reading tests have been used in diagnosing AD because of the difficulty of simultaneous processing of decryption, phonological, and semantic tasks.[9] The National Adult Reading Test,[10] which is the most widely used test, evaluates reading an English-language text out loud. It is a quick test featuring uncommon and irregularly spelled words, and it may be used for detecting MCI[11] as well as to gauge AD progression.[12]

Multiple studies have shown that reading ability is largely spared in AD since the task is partially automated.[13] While there are no detectable changes in reading ability in the early stages of the disease,[14] researchers have observed a significant decline in reading fluency in advanced stages,[15] although patients remain able to read short sentences.[16,17]

The purpose of this study is to analyse the temporal parameters of reading fluency by using an automatic, objective evaluation procedure. We will also evaluate this test's ability to discriminate between asymptomatic subjects and those with AD.

Method

Statistical design

The study was framed with a cross-sectional, analytical, observational, and retrospective design.

Patients

The sample was composed of 70 subjects with no prior history of alcohol abuse or drug consumption and no symptoms of depression (Geriatric Depression Scale score <10).

The group with AD ($n = 35$, 77.1% male and 22.9% female) consisted of patients at the national centre of reference for the care of patients with AD and other forms of dementia (CREA) in Salamanca, Spain. All patients had been diagnosed according to criteria established by the National Institute of Neurological and Communicative Disorders and the Alzheimer's Disease and Related Disorders Association. Their GDS score was 4 (mild AD).[18] Patients in this phase exhibit a slight language deficit in the processes of object naming and word comprehension. This is associated with anomic aphasia or impaired ability to search semantic memory. All patients had been enrolled in the CREA