Two Different Alzheimer Diseases in Men and Women: Clues From Advanced Neural Networks and Artificial Intelligence

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ABSTRACT

Background: Studies of the gender-related differences in the clinical presentation of Alzheimer’s disease (AD) have focused on specific aspects of the disease (e.g., circulating metabolites, cognitive capacity, or epidemiologic trends).

Objective: This study accounts for several descriptors of the disease simultaneously, providing a multidimensional analysis of a cohort of patients with AD.

Methods: Our analysis was conducted using self-organizing maps (SOMs). The high number (60) of independent variables (clinical, demographic, biochemical, and neuropsychological) observed in the study patients defines a complex and high-dimensional input space that can be processed by SOMs. Without supervision, SOMs examine nonlinear relations among the variables and cluster observations so that topologic relationships between variables correspond to the similarity of their distribution. Through such nonlinear auto-clustering, subsets of observations (i.e., clusters of subjects) can be identified in which essential information is concentrated. Each subject is identified by particular values of the variables (the record), and a specific set of variable values (the codebook) defines a distinct class.

Results: The study sample included 211 patients with mild to moderate AD (143 women, 68 men; mean [SD] age, 71.9 [7.2] years). All patients were assigned to 3 macroclasses—called A, B, and C—on the basis of matrix codebook neighborhoods. In terms of vectorial distance between codebooks, class A and B were quite similar, whereas the separation between class C and classes A and B was evident. The SOM distribution of values of variables across the output matrix did not show any specific pattern for most of the considered characteristics. However, we found only male patients in class C. This class distinction was not substantially changed when sex was removed from the database. Male and female patients were comparable with respect to dementia severity, demographic characteristics, psychiatric and behavioral symptoms, indicators of physical disability, and general health status.

Conclusions: SOMs indicate nonlinear multifactorial interactions among the descriptors of the features of AD that seem to be linked to sex and would have been missed by traditional statistical analysis. This finding may offer a novel epidemiologic rationale for research into different pathogenic mechanisms in men and women with AD. (Gender Med. 2005;2:106–117) Copyright © 2005 Excerpta Medica, Inc.

Key words: self-organizing maps, Alzheimer’s, gender, clustering.