Short Communication

APOE ε4 Allele and Financial Capacity Performance in Mild Alzheimer’s Disease: A Pilot Study

Vaitsa Giannouli* and Magda Tsolaki
School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Abstract
This study aims to explore a little investigated topic, i.e., whether the presence of the APOE ε4 allele in patients with a diagnosis of mild Alzheimer’s disease (AD) can influence financial capacity. Twenty-eight elders with mild AD carrying the APOE ε4 allele and 28 matched non-carrier patients were examined with an extensive battery of neuropsychological tests, and a specific test measuring financial capacity: Legal Capacity for Property Law Transactions Assessment Scale (LCPLTAS). The presence of the APOE ε4 allele does not differentiate the group of mild AD patients regarding a number of cognitive domains necessary for financial capacity scores as measured by LCPLTAS.

Keywords: APOE ε4, financial capacity, mild Alzheimer’s disease

INTRODUCTION

The Apolipoprotein E (APOE) ε4 allele is a major genetic risk factor for Alzheimer’s disease (AD) both for early-onset and late-onset AD as well as familial and sporadic cases [1, 2]. Research conducted to date has demonstrated diminished performance of financial capacity in AD without examining the influence of genetic factors [3]. Not only AD, but also other forms of neurocognitive disorders, such as Parkinson’s disease [4], vascular dementia [5], and amnestic mild cognitive impairment [6] have not been examined. Every individual has two copies of the gene and the combination of these copies determines the APOE genotype (ε2/ε2, ε2/ε3, ε2/ε4, ε3/ε3, ε3/ε4, and ε4/ε4).

*Correspondence to: Vraits Giannouliv, School of Medicine, Aristotle University of Thessaloniki 54124 Thessaloniki, Greece. E-mail: giannouliv@hotmail.com.

Significant negative associations have been found between the presence of the ε4 allele and different cognitive domains including global cognitive function, memory, executive function, and information processing speed [7]. However, scarce data exist for the group of already diagnosed AD patients and their cognitive performance related to APOE ε4 [8]. More specifically, this study aims to cover this knowledge gap regarding cognitive functioning by focusing on all related aspects of financial capacity, a neglected so far but complex cognitive capacity. Financial capacity includes a variety of activities and specific skills such as basic monetary skills, cash transactions, bank statement management, bill payment, financial conceptual knowledge, financial decision making, and knowledge of personal assets. These activities and skills are based on the abovementioned cognitive domains afflicted by APOE ε4. [3]. In this study, performance on financial capacity and subdomains is examined in two relevant groups, mild AD APOE
e4 carriers and mild AD APOE e4 non-carriers with similar demographic characteristics.

METHODS

Fifty-six Greek older adults (34 women, 22 men) participated in this study. Participants prior to enrolling to this study were examined following a common protocol in use in Papanikolaou Hospital. Diagnostic assessment consisted of medical history, standard assessment scales, physical examination, blood samples, and structural imaging (computerized tomography and/or magnetic resonance imaging). The diagnosis of AD was made prior to the enrollment according to National Institute of Neurological and Communicative Diseases and Stroke-Alzheimer’s Disease and Related Disorders Association (NINCDS-ARDA) by a trained geriatric neurologist. The neuropsychological assessment was completed during a pre-arranged visit at the Memory Clinic of Papanikolaou General Hospital and elderly day care centers. Next, the participants underwent an additional laboratory blood analysis for APOE genotype. The patients with a diagnosis of mild AD were divided in two groups: the control (e4 non-carriers) and experimental (e4 carriers) groups, which were matched in age [T(54) = 1.015, p = 0.315], gender (equally 28 men and women were distributed in the two groups), and years of education [T(54) = 0.018, p = 0.986] in order to eliminate the influence of these variables as possible confounders. The age for the mild AD APOE e4 carriers’ group was M = 73.67, SD = 6.78, and for the mild AD APOE e4 non-carriers was M = 73.60, SD = 8.39, while the education in years for the mild AD APOE e4 carriers’ group was M = 7.51, SD = 3.72, and for the mild AD APOE e4 non-carriers was M = 7.50, SD = 3.87.

Both groups had the same level of prior involvement with financial matters in their life as young adults (before the first symptoms of the disease), according to a brief interview with their caregivers (spouses and children). Subjects had a score of more than 4 in a 5-point Likert scale question asking whether they had managed successfully and alone their everyday financial affairs, a question that was also answered by their caregivers who accompanied them during the assessment meetings. Regarding their genetic APOE testing, n = 6 had e2/e3, n = 22 had e3/e3, n = 21 had e3/e4, n = 2 had e2/e4, and n = 5 had e4/e4 but at the time of the neuropsychological assessment the patients, their family members as well the examiner were not aware of the genetic test results.

A detailed neuropsychological battery covering a variety of cognitive areas was administered, including Mini-Mental State Examination (MMSE) [9], Test of Everyday Attention [10], Trail Making Test-Parts A and B [11], Rey-Osterrieth Complex Figure Test-copy condition and immediate and delayed recall conditions of the complex design [12], Rey Auditory Verbal Learning Test [13], Rivermead Behavioural Memory Test [14], Verbal Fluency Task [15], Neuropsychiatric Inventory [16], Instrumental Activities of Daily Living [17], Clinical Dementia Rating [18], and Functional-Cognitive Assessment Scale [19]. In addition to that, the Geriatric Depression Scale-15 (GDS-15) was used with a cutoff score of at least six to exclude individuals with depressive symptomatology [20].

Financial capacity was assessed with the Legal Capacity for Property Law Transactions Assessment Scale (LCPLTAS) [3]. LCPLTAS is culturally adapted for the Greek everyday financial reality and it consists of a total of seven domains, namely 1) basic monetary skills, 2) cash transactions, 3) bank statement management, 4) bill payment, 5) financial conceptual knowledge, 6) financial decision making, and 7) knowledge of personal assets. The LCPLTAS contains some items in the form of tasks, while some others are presented in the form of a semi-structured interview. For each question or task there is only one correct answer [3].

Participants were excluded as in similar studies [3–6] when the following criteria were present: a recorded history of stroke, a history of substance abuse, previous traumatic brain injury and related neurosurgical interventions, concomitant serious medical illness (significant visual and/or auditory impairment not corrected sufficiently by visual/auditory aids, a history of other neurologic or psychiatric disorder that may interfere with the patient’s neuropsychological performance).

Informed consent was obtained from all participants prior to their admission to the study and after a detailed description of the procedure. The study was approved by the Ethics Committee of the Aristotle University of Thessaloniki (as part of a larger study [3]) following the declaration of Helsinki.

Independent samples t-tests were performed with two comparison groups (mild AD APOE e4 carriers and mild AD APOE e4 non-carriers) and regarding MMSE and LCPLTAS scores. Probability values < 0.05 were considered statistically significant.
RESULTS

When comparisons were made between mild AD APOE e4 carriers and mild AD APOE e4 non-carriers, no statistically significant differences were found for MMSE scores \( T(54) = 0.405, p = 0.687, \text{Glass's } \Delta = 0.09 \), GDS \( T(54) = 0.554, p = 0.582, \text{Glass's } \Delta = 0.19 \), but also the financial capacity as examined by LCPTLAS total score \( T(54) = 0.048, p = 0.962, \text{Glass's } \Delta = 0.01 \) and the relevant subscales of LCPTLAS; basic monetary skills \( T(54) = 0.428, p = 0.671, \text{Glass's } \Delta = 0.10 \), cash transactions \( T(54) = 0.312, p = 0.756, \text{Glass's } \Delta = 0.10 \), bank statement management \( T(54) = 0.108, p = 0.914, \text{Glass's } \Delta = 0.12 \), financial conceptual knowledge \( T(54) = 0.242, p = 0.810, \text{Glass's } \Delta = 0.06 \), financial decision making \( T(54) = 0.171, p = 0.865, \text{Glass's } \Delta = 0.04 \), and knowledge of personal assets \( T(54) = 0.026, p = 0.979, \text{Glass's } \Delta = 0.06 \) (see Table 1).

In addition, nonparametric bootstrapped estimates of the 95% confidence intervals for mean difference were made. The procedure involved sampling with replacement (1,000 samples of 56 cases) from the original data [21]. The results are shown in Table 2, where all estimates do span the zero point, which suggests not rejecting the null hypothesis.

DISCUSSION

One critical, and commonly overlooked, feature of the APOE link to AD is that so far financial performance has been neglected in systematic testing. Although it has been supported that it may be a wise choice to perform the APOE genetic testing for the diagnosis of AD in elders with poor performance in a screening test and a family history of dementia [22], the above findings provide support that when detailed neuropsychological testing is performed, financial incapacity in mild AD is not influenced for APOE e4 gene carriers and non-carriers. It is imperative, at this point to make an epistemological annotation about the reductionism existing behind the stated hypothesis, that is whether and in what sense cognition can be reduced to genetics. This is a perpetual debate and an open issue [23], on which it is hard to draw causal interpretations. However, literature often brings about relevant issues, and it is worth probing and conversing about them [24]. The present study contributes to this issue by providing empirical counter evidence for supporting a direct relationship between the APOE e4 allele in AD and the performance in a relevant financial capacity empirical test, although the APOE e4 allele has been found to be linked to poorer cognitive performance in the domains of memory and processing speed in old age [25]. This evidence has to be taken into consideration

| Table 1 | Mean scores and SDs of MMSE, GDS and LCPTLAS total score and subscales in mild AD for APOE e4 gene carriers and non-carriers |
| --- | --- | --- | --- |
| Basic cognitive domains | APOE e4 | N | M | SD |
| MMSE | non-carrier | 28 | 17.32 | 8.91 |
| | carrier | 28 | 18.17 | 6.77 |
| GDS | non-carrier | 28 | 1.96 | 2.51 |
| | carrier | 28 | 2.46 | 4.05 |
| Total score LCPTLAS | non-carrier | 28 | 84.67 | 77.83 |
| | carrier | 28 | 83.75 | 67.42 |
| Subscales LCPTLAS | non-carrier | 28 | 5.96 | 5.38 |
| | Basic monetary skills | 28 | 5.39 | 4.58 |
| | Cash transactions | 28 | 2.42 | 2.76 |
| | Statement management | 28 | 2.64 | 2.36 |
| | Bill payment | 28 | 2.17 | 2.22 |
| | Conceptual knowledge | 28 | 12.78 | 12.01 |
| | Decision making | 28 | 45.21 | 42.64 |
| | Assets knowledge | 28 | 13.25 | 10.98 |

| Table 2 | Results from bootstrap estimations for independent samples t-tests |
| --- | --- | --- | --- | --- | --- |
| Financial capacity subdomains | Statistic | Bias | Std. error | 95% Confidence Interval |
| --- | --- | --- | --- | --- | --- |
| Lower | Upper |
| Basic monetary skills | 0.57143 | 0.03114 | 1.35729 | –2.17154 | 3.39357 |
| Cash transactions | –0.21429 | 0.05352 | 0.69016 | –1.51177 | 1.17857 |
| Statement management | 0.07143 | –0.03594 | 0.64834 | –1.30208 | 1.29021 |
| Bill payment | –0.39286 | 0.01616 | 0.75222 | –1.86819 | 1.07482 |
| Conceptual knowledge | –0.75000 | –0.05499 | 3.12678 | –6.97368 | 5.44930 |
| Decision making | 1.82143 | 0.07814 | 10.31696 | –18.79150 | 22.46268 |
| Assets knowledge | –0.07143 | –0.01546 | 2.71478 | –5.49673 | 5.41517 |
as there is a widely accepted influence (in the bibliography related to cognition and genetics) of a plethora of other hypothesized mediating factors (e.g., socioeconomic factors) [26].

One of the major limitations of our study is the small sample size. Given that this is the first study of its kind to show that APOE e4 has no differentiating power on financial capacity performance in the group of mild AD patients, future research could include larger samples [27, 28] and different stages and types of neurocognitive disorders in old age.

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CONFLICT OF INTEREST

The authors have no conflict of interest to report.

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