Educational Attainment and Socioeconomic Status of Patients With Autopsy-Confirmed Alzheimer Disease

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Objective: To determine whether patients with autopsy-confirmed Alzheimer disease (AD) have different educational attainment and socioeconomic status than subjects without neurodegenerative disease.

Design: Comparison of 2 groups of autopsied patients. Information on education and occupation was obtained by telephone interview of relatives conducted post mortem.

Patients: One hundred fifteen patients enrolled in the University of Western Ontario Dementia Study with dementia and fulfilling diagnostic criteria of AD at autopsy were compared with 142 patients 65 years or older without dementia who died in the hospital and in whom autopsy did not show neurodegenerative disease.

Main Outcome Measures: Highest education level attained, years of education, occupation, and socioeconomic and income levels. All results were adjusted for sex, age at time of death, and year of birth.

Results: There were no statistically significant differences in education, occupation, or socioeconomic and income levels between the groups.

Conclusions: There is no evidence that educational attainment is different in patients with AD than in subjects who die in the hospital from other diseases. These results indicate that education does not protect against advanced AD.

Arch Neurol. 2000;57:85-89

Familial early-onset varieties of Alzheimer disease (AD) can be explained by mutations in the β-amyloid protein precursor gene, the presenilin genes, and other, undiscovered genes. The common sporadic late-onset variety is more complex. The ε4 allele of apolipoprotein E is undoubtedly a strong risk factor and other genetic polymorphisms have been proposed as additional contributors to the risk of developing the disease. However, environmental factors must also play a role, as indicated by the common discrepancy in expression of the disease among identical twins. Currently, the only nongenetic factors to be upheld by replication in epidemiological studies are head trauma and education. The latter is the subject of the present report.

Higher education attainment has been reported to reduce the risk of dementia, as determined by population-based prevalence studies. The type of dementia is often but not always identified as AD. The weakness of these studies is the diagnosis of dementia, which is at times determined following brief cognitive tests and the application of rating scales without assessment by a physician, the use of imaging, or long-term follow-up. Education can artifactually distort performance on these tests, leading to incorrect classification of subjects. Moreover, several well-conducted studies, some with follow-up, found no association of education with the prevalence of dementia. Studies investigating the incidence of dementia are also divided among those finding and not finding an association between education and the risk of dementia.

Assuming that an inverse relationship exists between educational attainment and the risk of dementia, 2 types of mechanisms could mediate this phenomenon. The brain reserve hypothesis postulates that individuals possess a cognitive reserve above the threshold for dementia; that education promotes the development of more efficient cerebral activity, possibly through the formation of more abundant or proficient synapses; and that the onset and progression of the degenerative process may be unrelated to education, but its manifestation as dementia is delayed in subjects who are better educated because of their greater cognitive reserve. Alternatively, the brain-
RESULTS

The distribution of sex, age at time of death, and year of birth were all significantly different in the 2 groups (Table 1); thus, adjustments to the percentages and means were essential to compare them. Highest educational attainment was not statistically different in the 2 groups (Table 2). Although occupation level was statistically nonsignificant in the logistic regression analysis, it is still noteworthy that patients with AD were 2.4 times more likely (15.6% vs 6.4%) to be in a low-income occupation than control patients, and control patients were 2.3 times more likely (38.0% vs 16.8%) to be homemakers than patients with AD (Table 2). Neither the estimated socioeconomic nor income levels were significant. Similar results were observed among the occupation variables when the analyses were repeated for the subgroup of patients in the workforce (Table 3).

COMMENT

Interpretation of the results of the current study is limited by the fact that neither the AD nor the control group represents a random sample of their respective reference populations. With regard to the AD group, it is likely that subjects who consent to participate in a research project are better educated than individuals who refuse. The high autopsy rate (70%) and the lack of difference for a number of demographic and clinical measures for subjects who had an autopsy and those who did not suggest that the impact of additional bias is limited. With respect to the control group, the Canadian...
Universal health care coverage system substantially reduces hospital admission bias in comparison with other countries. However, the population attending a university hospital may be better educated than the Canadian average, and education may influence consent to autopsy. These caveats, which apply to virtually any universal health care coverage system, should be considered in interpreting the results obtained, which simply reflect the comparison of outpatient and inpatient subgroups attending the same hospital.

Our data indicate that the educational attainment for patients with autopsy-confirmed AD is no different from that of a sample of individuals who underwent autopsies at the same hospital. These results are not incompatible with some aspects of the brain reserve hypothesis, since most patients with AD who underwent autopsies were in the terminal stages of the disease, whereas the expected effect of education would be manifested during the early stage of mild dementia. However, our results are inconsistent with a persistent protective effect of education in advanced AD. The only other study to examine the effect of education on the development of AD in an autopsy-confirmed series was likewise unable to confirm the predictions of the brain reserve hypothesis.

In previous articles, in which we have examined the age of onset and time course of AD in University of Western Ontario Dementia Study patients, we have shown that low educational attainment was associated with a delayed onset of the disease. This effect decreased but persisted after correction for year of birth and might be explained by the association of cerebral infarcts with both low education and advanced age. The unconfirmed results of the Nun Study suggest that the presence of cerebral infarcts, even minor ones, markedly increases the clinical manifestations of AD-type brain lesions. The brain-battering hypothesis (del Ser et al) proposes that the protective effect of education is mediated indirectly...
through SES by reducing physical assault on the brain in the form of toxins and infarcts. The observation that patients with AD are between 2 and 3 times more likely to have worked in low-income occupations raises the possibility that factors associated with SES play a role in the development of the disease. However, the difference does not reach the level of statistical significance, and at this point the conservative view must be that no effect of SES has been demonstrated. However, if expanded studies were to demonstrate the role of SES in the development of AD, the fact that homemakers do not participate in the increased risk of low-income occupations but the opposite suggests that the causes of AD should be sought in the differences in lifestyle and level of exposure to injurious agents or substances, rather than in the use of the brain for intellectual activities traditionally associated with formal education.

Accepted for publication June 10, 1999.

This study was supported by grant MT-12707 from the Medical Research Council of Canada, Ottawa, Ontario (Dr Munoz), and by grant 98/3157 from the Fondo de Investigación del Sistema Nacional de Salud of Spain.

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REFERENCES


