Incidence of chronic disease in the aging population: do social factors matter?

Our experience on the relationship between level of education and dementia

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Prevalence of probable Alzheimer’s Disease according to educational level in elderly people living at home

- No education or primary level without diploma: 5.4%
- Primary level with diploma: 1.7%
- Secondary level: 0.4%
- University level: 0.4%
Are sex and educational level independent predictors of dementia and Alzheimer's disease? Incidence data from the PAQUID project Letenneur L. et al JNNP 1999

The risks of dementia and Alzheimer's disease were associated with a lower educational attainment (primary school without diploma vs higher level)

hazard ratio=1.8, p<0.001
How could we explain a protective effect of education?

- Enhancement of reserve capacity of the brain
- Better management of risk factors for dementia by highly educated subjects
Brain Aging and AD

Morbide Process

Reserve Capacity
Anatomo-pathological studies on subjects without clinical AD but with histological AD

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number</th>
<th>Mean Age (in years)</th>
<th>MMSE</th>
<th>CERAD&lt;sup&gt;a&lt;/sup&gt; (%)</th>
<th>NIA-Reagan&lt;sup&gt;b&lt;/sup&gt; (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis, 1999</td>
<td>59</td>
<td>84</td>
<td>28</td>
<td>25</td>
<td>12</td>
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<tr>
<td>Neuropathol Group, 2001</td>
<td>109</td>
<td>85</td>
<td>-</td>
<td>33</td>
<td>-</td>
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<td>Knopman, 2003</td>
<td>36</td>
<td>85</td>
<td>28</td>
<td>18</td>
<td>10</td>
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<td>Galvin, 2005</td>
<td>41</td>
<td>85</td>
<td>-</td>
<td>34</td>
<td>29</td>
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<td>Bennett, 2006</td>
<td>134</td>
<td>85</td>
<td>28</td>
<td>45</td>
<td>37</td>
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<td>Roe, 2007</td>
<td>265/320</td>
<td>85</td>
<td>25</td>
<td>14</td>
<td>19</td>
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<tr>
<td>Price, 2009</td>
<td>97</td>
<td>84</td>
<td>28</td>
<td>20</td>
<td>17</td>
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</table>

<sup>a</sup> Consortium to Establish a Registry for Alzheimer's disease neuropathologic criteria for probable AD (CERAD)

<sup>b</sup> NIA-Reagan histological criteria for probable AD
How education could contribute to the reserve capacity?
Figure 1: Brain areas of grey matter showing a positive association with subjects with a high education level compared to a low level in A and C adjusting for age and gender; in B and D adjusting for age, gender and TIV (n=331) (contrast with a t-test, a p-value corrected < 0.05 by FDR and an extend cluster threshold of 100).
Education and Dementia: the Nun study
The Nun Study

Clinically silent AD, neuronal hypertrophy, and linguistic skills in early life  Neurology® 2009;73:665-673
Study of the pre-dementia phase of AD according to the education level of participants

- Follow-up visits: 1, 3, 5, 8, 10, 13, 15, 17 and 20-year visit of the PAQUID cohort

 предостережение Retrospective analysis of the trajectory of:

✓ 392 persons diagnosed with Alzheimer dementia

✓ divided in 2 groups according to educational level: those who achieved the primary level certificate and those who did not achieve any diploma
  - 234 with primary level certificate (called highly educated);
    mean age: 76.0 (SD= 6.1)
  - 158 with no diploma (called low educated);
    mean age: 76.8 (SD= 6.0)
Digit Symbol Substitution task

High education

Low education

Controls

Pre-demented
Incidence of dementia according to the educational level

- Certificat d'études primaire ou plus
- Sans diplôme

Graph showing the incidence of dementia against age.
How could we explain a protective effect of education?

- Enhancement of reserve capacity of the brain
- Better management of risk factors for dementia by highly educated subjects
For each WMH

- Volume
- Coordinates (in Talairach space and in the native space)
- Type: deep WM, periventricular, etc.
- Intensity
- Distance to ventricle

For each subject

- Density cards of WMH (native space and MNI)
- Volume of WMH by type
- Volume of the mask of WM
- Burden of WMH
Comparison between change in White Matter Hyperintensities (WMH) in high versus low educated subjects. Repeated MRI in 3C Bordeaux cohorte (n=382)

<table>
<thead>
<tr>
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<th>Without adjustment on vascular factors</th>
<th>With adjustment on vascular factors</th>
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<tbody>
<tr>
<td></td>
<td>$\beta$ value, IC à 95%</td>
<td>$\beta$ value, IC à 95%</td>
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<tr>
<td>Total WMH change</td>
<td>-0.07 [-0.13 ; -0.02]</td>
<td>-0.09 [-0.15 ; -0.03]</td>
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<tr>
<td>Periventricular WMH</td>
<td>-0.06 [-0.11 ; -0.01]</td>
<td>-0.08 [-0.14 ; -0.02]</td>
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<tr>
<td>Deep WMH</td>
<td>-0.01 [-0.02 ; -0.001]</td>
<td>-0.01 [-0.02 ; 0.001]</td>
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Foubert et al, submitted
Conclusion

- Education is one of the strongest protective factor for dementia and AD
- Education enhance the reserve capacities of the brain (both brain and cognitive reserves)
- The better management of vascular risk factors in highly educated subjects could also participate to the protective effect