Fish Consumption and Brain Structure in a Multi-Site Community Cohort

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E-Poster

Introduction:

In the growing elderly population, the long-term effect of the diet on the brain is of great interest. A recent study showed greater brain volume in elderly subjects who ate fish regularly (Raji 2011). Specifically, those who ate baked fish at least once a week had greater gray matter volumes in three key areas of the brain involved in memory and cognition: the hippocampus, the posterior cingulate, and orbitofrontal cortex. The prior study assessed 260 subjects from the University of Pittsburgh, using voxel-based morphometry (VBM) to measure gray matter volume.

Here we expanded on that prior work, assessing 3-D volumetric MRI scans of 650 cognitively normal individuals from the Cardiovascular Health Study of whom 309 consumed fish on at least a weekly basis. As opposed to studies of gray matter volume, tensor-based morphometry (TBM) was used to determine whether regional brain volumes, throughout the brain, are related to fish consumption. Based on recent studies, we hypothesized that measures of fish consumption would correlate with temporal and frontal volumes.

Methods:

3D T1-weighted MRI scans were acquired from 650 normal elderly subjects (mean age: 73.5±3.7 years; 269 men/381 women) at four different university sites: Pittsburgh, UC Davis, Wake Forest and Johns Hopkins. Information on fish consumption was gathered using the National Cancer Institute Food Frequency Questionnaire. A high-resolution average brain template was created to represent common anatomical features of the study population. All individual brains were non-linearly aligned to the brain template, using inverse-consistent elastic intensity-based registration (Leow 2005). These mappings were used to quantify 3D patterns of volume deficit or excess relative to the brain template (cross-sectional measures). At each voxel in the brain, multiple regression was used to assess associations between regional brain volumes and (1) age, (2) sex, (3) race, (4) site and (5) daily or weekly fish consumption. Statistical maps were corrected for multiple comparisons using

the False Discovery Rate (FDR).

Results:

Fish consumption was associated with greater brain volume overall (FDR q=0.05, critical P=0.000008). After controlling for age, sex, race and site differences, consuming fish at least once per week was also associated with greater regional volumes in the frontal lobe (FDR q=0.05, critical P=0.0001), including the orbitofrontal cortex. Those who ate fish showed greater tissue volume in this region as compared with non-fish eaters, on average. The association between fish consumption and temporal lobe volume was not significant after correction for multiple comparisons.

Conclusions:

Consuming fish at least once per week is related to larger volumes in areas of the brain responsible for memory and cognition in non-impaired elderly individuals. This is consistent with prior work. The main strength of this study was the use of a well-characterized community cohort in which lifestyle variables and neuroimaging were available with large sample size. Our TBM analyses also used multivariate models to examine the influence of one variable while controlling for the confounding influence of several others, such as age, sex and site differences.

These findings are consistent with a growing literature linking lifestyle factors to brain structure (e.g., Raji 2010). Lifestyle choices are associated with biological benefits to brain tissue, detectable at the group level using brain imaging. Often, areas associated with lifestyle choices such as physical activity, fish intake and other dietary factors are critical for cognition. These include the hippocampus and frontal lobes (Erickson 2010). Understanding the influence of lifestyle factors on brain structure may lead to better strategies to improve brain health with aging.

Lifespan Development:

Aging

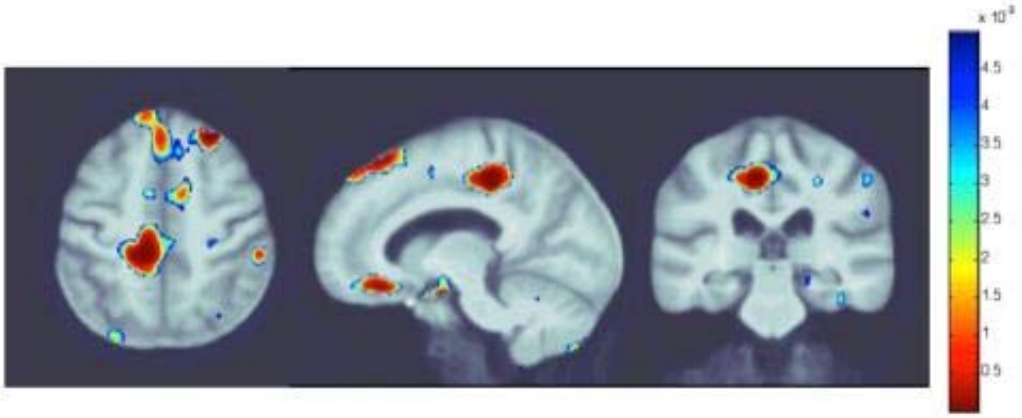

Figure 1: Correlations of regional brain volume and fish consumption are shown, in this cohort of normal elderly subjects (n=650). In the highlighted regions, higher regional brain volumes are significantly associated with fish consumption in the whole brain (critical P = .000008) and frontal lobe (critical P = .0001).

Abstract Information

References

Raji C.A., et al., (2011), 'Regular Fish Consumption Is Associated with Larger Gray Matter Volumes

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Leow A.D., et al., (2005), 'Inverse consistent mapping in 3D deformable image registration: its construction and statistical properties', Information Processing in Medical Imaging (IPMI), Glenwood Springs, Colorado, LNCS 2565, pp. 493–503.

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