

Thyroid Hormones are related to Brain Structure Six Years Later in 437 Euthyroid Elderly

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Introduction

Thyroid hormones influence metabolism throughout life and have key roles in nervous system development and cardiovascular health. In old age, thyroid function is related to cardiovascular and cognitive function [1-3], even for individuals whose thyroid hormone levels are within the clinically normal range. Clinical thyroid dysfunction also increases the risk for cognitive impairment and Alzheimer's disease [4].

Understanding how subclinical alterations in measures of thyroid function relate to structural brain integrity over time in the healthy elderly could provide evidence to support trials of modifying thyroid hormone levels to reduce cognitive decline.

Methods

Subjects

We analyzed 437 cognitively normal elderly individuals (age: 77.5 ± 3.8 years; 240 women, 197 men) from the Cardiovascular Health Study (CHS), a multicenter population study. We included only participants who were not taking thyroid medication and did not have overt thyroid dysfunction.

Thyroid Function Tests

Thyroid function tests – measures of thyroid stimulating hormone (TSH), thyroxine (fT4), triiodothyronine (T3) – were related to structural brain 1.5T MRI scans obtained six years later.

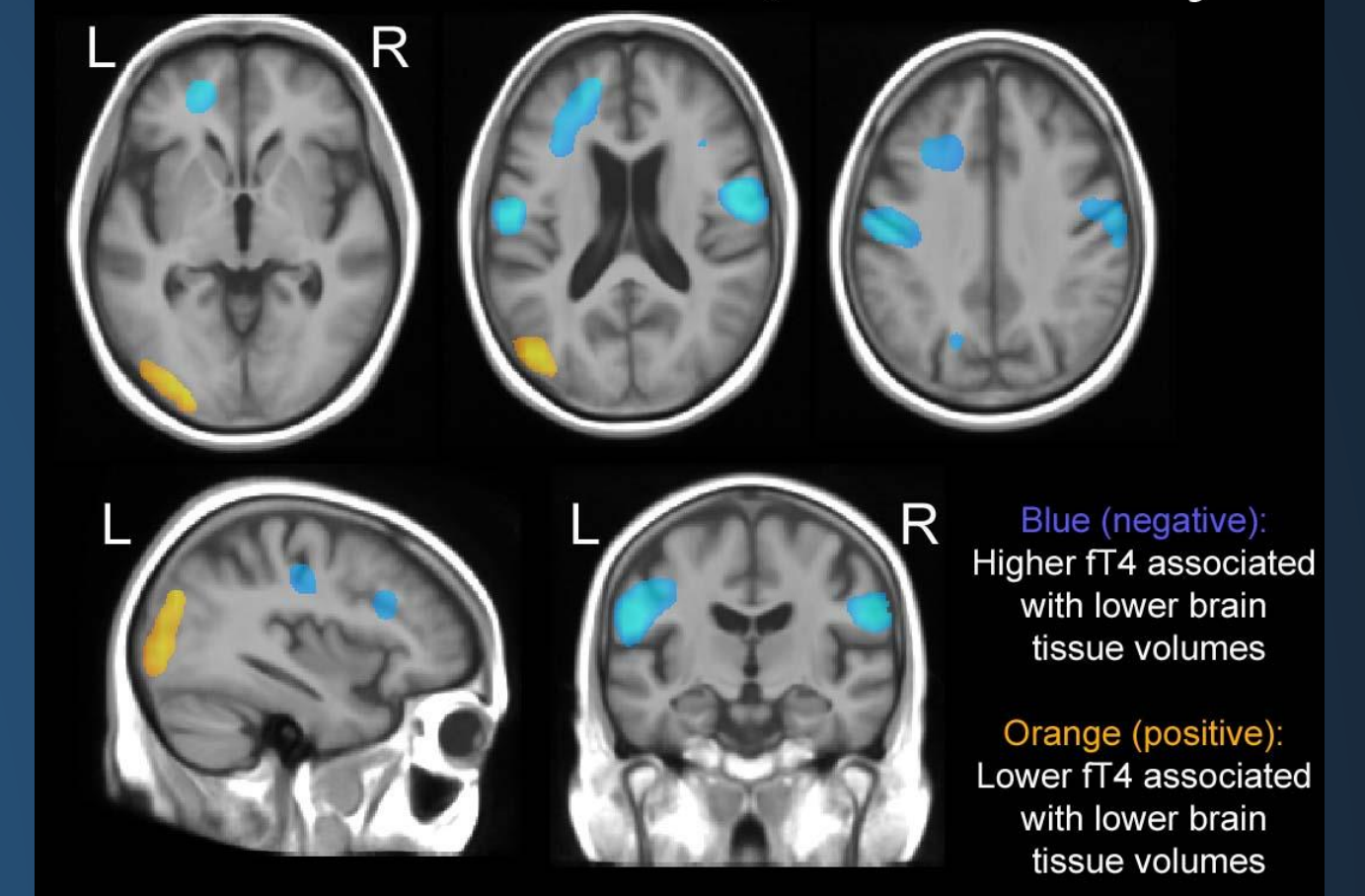
Tensor Based Morphometry Analysis

Regional brain volumes were measured with tensor-based morphometry (TBM), which measures brain atrophy with high sensitivity to clinically significant differences [5]. A minimal deformation template (MDT) was created from 40 representative CHS participants. All processed scans were non-linearly aligned to MDT, resulting in a common coordinate system [6]. 3D Jacobian maps measured relative volume differences between each participant and the common template, representing the relative expansion or contraction at each brain voxel.

Results

In elderly individuals with clinically normal thyroid hormone levels, higher and lower fT4 levels were significantly associated with patterns of reduced brain tissue volume six years later. Higher fT4 was related to lower bilateral frontal and right parietal gray matter, left thalamus, and right temporal and occipital white matter volumes. Lower fT4 was related to lower volumes in bilateral visual and right auditory regions. No significant associations were found for TSH or T3 levels.

fT4 Levels in Euthyroid Elderly



Discussion

Thyroid hormone levels are significantly associated with future brain volumes in non-demented elderly individuals who have thyroid hormone levels in the clinically normal range. Higher fT4 was associated with smaller brain tissue volumes in frontal, primary motor and sensory areas, higher order visual regions, and thalamus. Lower fT4 was associated with smaller brain tissue volumes in primary and secondary visual areas.

This pattern of brain areas is consistent with prior reports that subclinical hyperthyroidism is linked with poorer cognition, memory, visuospatial, and executive function in the elderly [8, 9].

Higher levels of one thyroid hormone (fT4) are linked to brain volumes that are lower in some areas but higher in others, suggesting that perturbations in thyroid hormone levels may contribute to brain tissue loss in old age.

References

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