

Association of MRS Measures in the Brain with Body Mass

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INTRODUCTION:

Alterations of ¹H-MRS-observed brain metabolite distributions are best evaluated using comparisons against normative data that is matched to the subject (or subject group) by age, region, and tissue type. Previous studies have suggested that adiposity, as indicated by the body mass index (BMI) is additionally associated with metabolite concentrations [1, 2]. To further examine this finding a retrospective analysis of brain MR spectroscopic imaging (MRSI) studies has been carried out to examine the associations of BMI and body weight with metabolite concentrations, B0 homogeneity, and spectral linewidth.

METHODS:

MRI and MRSI studies of the brain were obtained at 3 Tesla from 140 subjects for whom height and weight information was available. The MRSI acquisition used lipid inversion-nulling and TE/TR/TI = 70/1710/198 ms, with data obtained over a 135 mm slab covering the cerebrum. Data were processed using the MIDAS package [3, 4] to map N-acetylaspartate (NAA), creatine (Cre), and choline (Cho). The parametric spectral analysis used a Gaussian lineshape model. Processing included determination of grey-matter (GM), white-matter (WM) and CSF content at each MRSI voxel; signal normalization of individual metabolite images; and non-linear spatial registration to a spatial reference that was mapped to a lobar brain atlas.

A multivariable linear regression analysis was used to examine associations of the metabolite and spectral parameters in each lobar brain region for GM and WM with gender, age, and BMI, and interactions between gender and age and gender and BMI. The analysis was also repeated using weight in place of BMI. Additional voxel-based analyses examined spatial distributions of the metabolite and spectral parameters as a function of BMI and age.

RESULTS:

The selected subject group was aged 18 to 84, median 36 years, with 75 with normal BMI, 49 overweight, and 16 obese. Regional analyses indicated significant associations of all metabolites with age and gender, in agreement with a previous report [4]. Significant associations with BMI were found for increased Cho in frontal and parietal GM (males only), and decreased NAA and Cre in occipital WM and cerebellum. Associations of BMI with increased spectral linewidth were also found in frontal and parietal lobes, and decreased linewidth in cerebellum.

Maps of the slope of voxel-based regression analyses of the metabolite values against BMI indicated similarities with the distributions shown in maps created by regression analysis of the linewidth against BMI. Results for both the lobar and image-based analyses were very similar when body weight was used as the regression parameter instead of BMI.

Maps of mean B0 for groups of 20 low-BMI (Fig. 1a) and high-BMI (Fig. 1b) subjects revealed different spatial distributions, predominately in frontal and inferior regions.

CONCLUSIONS:

While associations of metabolite concentrations with BMI were found, the locations of these findings were not consistent with previous reports and the relative changes within each region were not consistent with known biological processes that result in altered metabolite concentrations. In light of the additional findings of interactions between B0 and linewidth with BMI, as well as interactions between BMI and age, and age and spectral linewidth, these results indicate that systematic errors in spectral fitting associated with B0-inhomogeneity associated lineshape distortions may play a role in the apparent observation of associations of metabolite values with BMI.

For the age range of this subject group, this study does not support an organic cause for alteration of altered brain metabolite distributions in healthy subjects.

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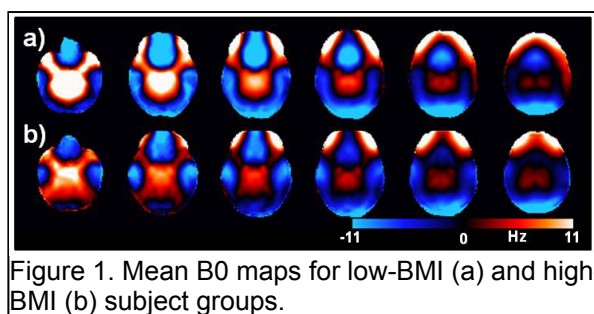


Figure 1. Mean B0 maps for low-BMI (a) and high-BMI (b) subject groups.