Body Mass Index and Neuronal Viability in Healthy Cognitively Normal Elderly- A Magnetic Resonance Spectroscopy Study

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Introduction: Recent studies suggest that excessive body weight is associated with brain structural alterations [1], poorer executive function [2], and lower prefrontal glucose metabolism [3]. We recently demonstrated in a healthy middle-aged cohort (mean age 41.7±8.5 years) a relationship between higher body mass index (**BMI**) and widespread decreases in concentrations of N-acetyl-asparte (**NAA**, marker of neuronal viability, associated with glucose utilization), especially in frontal lobe [4]. Here, we aimed to replicate such relationships in a healthy elderly population.

Methods: We scanned 23 healthy, cognitively normal, elderly participants (69.4 ± 6.9 years; 12 females) with STEAM (TE/TM/TR = 12/12/2000 ms, voxel size = 2cm x 2cm x 2cm) at 4T to measure NAA, glutamate (**Glu**, likely reflecting neuronal viability), choline-containing compounds (Cho, involved in membrane metabolism), and creatine- containing compounds (Cr, involved in high energy metabolism) from anterior (**ACC**) and posterior cingulate cortices (**PCC**). Optimized SLR RF pulses used for localization (bandwidth=4.5 kHz) were designed using Matlab™-based software Matpulse [5] .Water suppression was achieved using variable pulse power and optimized relaxation delays (VAPOR) scheme. The spectroscopic data were processed off-line with automated software SI-TOOLS [6]. The absolute metabolite concentrations were not calculated; we used ratios to Cr and Cho instead.

Results In ACC and after correction for age, higher BMI was associated with lower NAA/Cr (β=-0.574, p=0.006), lower NAA/Cho (β=-0.562, p=0.008), lower Glu/Cr (β=-0.459, p=0.022) and lower Glu/Cho (β=-0.528, p=0.009). These associations were not significant in PCC (all β>-0.38, p>0.09). In both regions, NAA/Cr correlated with Glu/Cr (rho>0.47, p<0.01) and NAA/Cho was associated with Glu/Cho (rho>0.063, all p=0.001). The Cho/Cr, m-Ino/Cr, m-Ino/Cho ratios were not associated with BMI in any region (all β>-0.327, p>0.14, uncorrected). Age was a significant predictor for Glu/Cr (β=-0.456, p=0.023) and Glu/Cho (β=-0.382, p=0.05) in ACC, but not in PCC (β>-0.149, p>0.50). Neither NAA/Cr nor NAA/Cho were related to age in any region (all β>0.05, p>0.23).

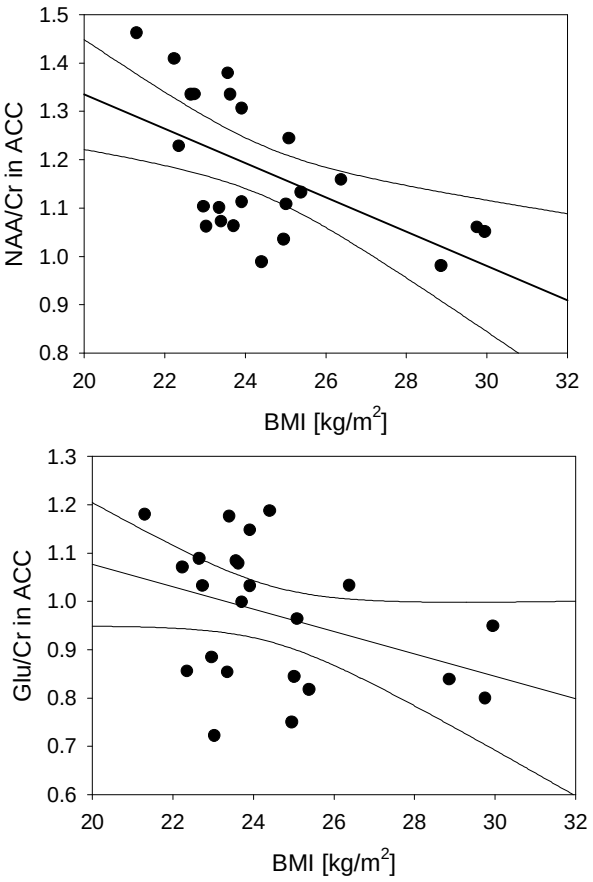

Figure: NAA/Cr and Glu/Cr as function of BMI in ACC.

Discussion: This observed pattern is consistent with associations between NAA and BMI in frontal gray matter, but not in parietal gray matter, observed in our previous study. Additionally, ACC is involved in emotional regulation, impulse control, and goal directed behavior [7]. Thus poorer neuronal integrity in participants with higher BMI may underlie deregulation of ACC functions and thus be associated with maintenance of weight problems.

References:

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