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Brain structure, executive function and appetitive traits in adolescent obesity

Introduction

Children with obesity show differences in brain structure, executive function and appetitive traits when compared to lean peers[1-4]. Results of imaging studies, however, have been contradictory. Therefore, we investigate whether childhood obesity is associated with differences in brain structure and whether differences associate with executive function and appetitive traits.

Methods

A cross-sectional case-control study among 23 obese and 19 lean control subjects, aged 12-16 years, was conducted. Brain structures were measured by MRI using cortical thickness and subcortical volumes. Appetitive traits were measured by the Child Eating Behavior Questionnaire and executive function by a Stop Signal Task and a Choice Delay Task. Associations between brain structures and appetitive traits or executive function tests were investigated using linear regression analysis.

Table 1 Results of neuropsychological tasks, questionnaires and segmentation

	Lean (n = 19)	Obese (n = 23)	p-value	p-value FDR
	Task-based measures			
Mean SSRT ms	256 (199-305)	253 (221-300)	0.90	-
CDT large rewards	14 (7-20)	10 (5-12)	0.07	-
	Questionnaire measures			
CEBQ Satiety responsiveness	2.6 (2.2-2.9)	2.3 (1.6-2.7)	0.063	-
CEBQ Food responsiveness	1.8 (1.6-2.2)	3.3 (2.4-3.7)	< 0.001	-
CEBQ Enjoyment of food	3.3 (3.0-3.6)	3.7 (3.2-3.9)	0.06	-
CEBQ Emotional Overeating	1.6 (1.3-2.0)	3.0 (2.0-3.6)	<0.001	-
CEBQ Desire to Drink	2.3 (1.7-2.8)	3.0 (2.0-3.4)	0.17	-
	Cortical thickness (mm)			
Orbitofrontal cortex	2.90 (0.02)	2.83 (0.04)	0.21	0.49
Anterior cingulate cortex	3.20 (0.05)	3.17 (0.03)	0.78	0.97
Frontal pole	2.96 (0.06)	3.00 (0.07)	0.97	0.97
Inferior frontal gyrus	2.93 (0.03)	2.92 (0.04)	0.86	0.97
Middle frontal gyrus	2.75 (0.02)	2.71 (0.04)	0.61	0.85
Superior frontal gyrus	3.18 (0.03)	3.12 (0.04)	0.41	0.72
Insular cortex	3.25 (0.03)	3.23 (0.04)	0.57	0.85
	Subcortical volumes (mL)			
Amygdala	1.24 (0.03)	1.35 (0.04)	0.03	0.21
Hippocampus	3.91 (0.06)	3.89 (0.09)	0.93	0.97
Nucleus Accumbens	0.50 (0.02)	0.54 (0.02)	0.12	0.42
Caudate Nucleus	4.02 (0.09)	3.90 (0.07)	0.31	0.62
Putamen	5.01 (0.09)	5.24 (0.10)	0.19	0.49

Table1. Task and questionnaire data are presented as median with interquartile range and are derived from non-parametric testing. Segmentation data are presented as mean with standard error and are derived from linear regression analysis adjusted for age and sex. Abbreviations: SSRT: stop signal reaction time; CDT: choice delay task; CEBQ: Child Eating Behaviour Questionnaire, FDR: false discovery rate.

Figure 1

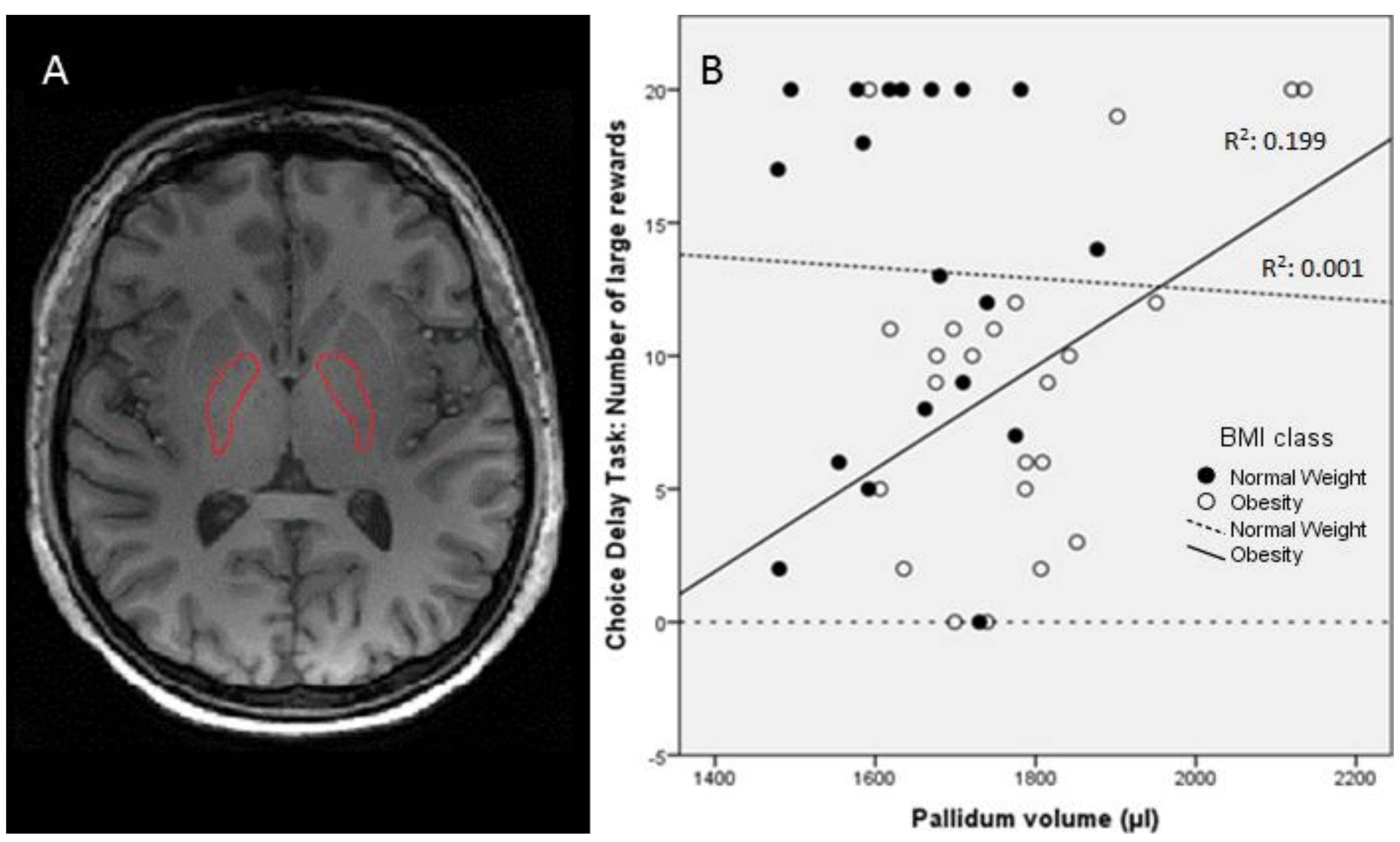

Figure 1. A: Example of the pallidum ROI in an obese participant; B: scatterplot of the relationship between pallidum volume and choice delay task performance in obese and lean subjects.

Results

Obese adolescents had larger volumes of the pallidum; 1.78 mL (SE 0.03, p=0.014), when compared to controls; 1.65 mL (SE 0.02). In the obese group, increased pallidal volume was positively associated with the ability to delay reward in the Choice Delay Task (p=0.012, figure 1B).

Conclusions

The positive association of pallidal volumes and Choice Delay Task found in obese adolescents supports the hypothesis that the pallidum plays an important role in executive dysfunction described in obese children.

References

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