

SALÃO DE
INICIAÇÃO CIENTÍFICA
XXIX SIC

UFRGS
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Evento	Salão UFRGS 2017: SIC - XXIX SALÃO DE INICIAÇÃO CIENTÍFICA DA UFRGS
Ano	2017
Local	Campus do Vale
Título	The effect of transcranial direct current stimulation (tDCS) associated with hypocaloric diet in subjects with different degrees of glucose tolerance
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The effect of transcranial direct current stimulation (tDCS) associated with hypocaloric diet in subjects with different degrees of glucose tolerance

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Abstract:

Background and aims: Non-adherence to lifestyle modifications is an important determinant of failure to treat obesity. The dorsolateral prefrontal cortex (DLPFC) plays an important role in appetite and food intake regulation and may be a target for electric brain stimulation, a new treatment modality that has been used in conditions such as depression and drug addiction. The aim of this study was to test the effect of active anodal tDCS (a-tDCS) over the right DLPFC (rDLPFC) associated with a hypocaloric diet on weight loss in overweight or obese adults with different degrees of glucose tolerance.

Materials and methods: In this randomized, placebo-controlled, double-blind pilot study, 10 overweight or obese adults with different degrees of glucose tolerance (NGT: normal glucose tolerance, IGM: impaired glucose metabolism, T2D: type 2 diabetes), aged 20-50 years, completed a 4-week (20 sessions) of fixed-dose tDCS (2mA, 20 min). Subjects were randomized in a 1:1 ratio to receive one of two types of intervention: (1) active a-tDCS + hypocaloric diet (*Active*), or (2) sham a-tDCS + hypocaloric diet (*Sham*), both delivered over the rDLPFC. To determine body mass index (BMI, in Kg/m²), body weight (BW, in kg) and height (m) were assessed at baseline (t₀). Weight loss was verified weekly with measures of BW assessed at visits 5 (t₅), 10 (t₁₀), 15 (t₁₅), 20 (t₂₀), and at the last visit of the study (t_F). Blood samples were collected at t₀ and t_F for 2-h oral glucose tolerance test (OGTT), for standard 4-h meal tolerance test (MTT) glucose and insulin measurements, and for HbA_{1c} determination. Changes in BMI, BW and area under the curve (AUCs) were analyzed with generalized estimating equations (GEE) and Bonferroni post-hoc testing for normally distributed continuous variables; descriptive statistics are reported as means±SD or %.

Results: 10 subjects completed the study on this interim analysis (female 60%, obese 70%, mean age 38.1±4.6 years, BMI 30.9±2.4 kg/m², IGM 20%, T2D 10%). Reduction of BW was not significant between groups at the end of the study (GEE, p=0.091). However, reduction in BMI was greater in the *Active* than in the *Sham* group (GEE, p=0.002). Changes over the time in BMI (t_F-t₀; mean±SE) were -1.0±0.2 kg/m² in the *Active* group and -0.6±0.2 kg/m² in the *Sham* group (p<0.001). Although there was a greater reduction in the AUC for glucose (GEE: p=0.070) and insulin (GEE: p=0.083) from t₀ to t_F in the *Active* vs *Sham* group during the MTT, these changes did not reach statistical differences.

Conclusion: This preliminary analysis suggests that repetitive active a-tDCS may be a promising non-invasive technique that could be used to increase BMI reduction in overweight or obese individuals with different degrees of glucose tolerance on a low-calorie diet.

This study was approved by the Institutional Review Board.