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The effect of transcranial direct current stimulation associated with hypocaloric diet over the type of carbohydrate ingested by overweight or obese adults

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Abstract:

Background and aims: Dietary interventions for obesity that involve caloric restriction usually lead to food craving, a condition characterized by an increased intake of high-calorie and high-glycemic index foods. The dorsolateral prefrontal cortex (DLPFC) plays an important role in appetite and food intake regulation, and may be an interesting target to electric brain stimulation, a new modality of treatment that has been associated with food craving reduction, especially for carbohydrate. Therefore, the aim of this study is to analyze the effect of 20 sessions of tDCS over the right DLPFC (rDLPFC) associated with a hypocaloric diet on the quality of carbohydrate consumed by overweight or obese adults.

Materials and methods: In this randomized, placebo-controlled, double-blind study, 20 overweight or obese adults, aged 20-50 years, completed a 4-week (20 sessions) protocol 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 tDCS+hypocaloric diet (AG), or (2) sham tDCS+hypocaloric diet (SG), both over the rDLPFC. The dietary behavior was assessed by 3-day food records (2 week-days; 1 weekend-day) on three times: baseline (t_0), first fortnight (t_{15}) and final (t_F). The quality of carbohydrate consumed was assessed by the mean glycemic index (MGI) and mean glycemic load (MGL) per meal per day. Body mass index (BMI) and body weight (BW) were assessed t_0 and at t_F . Blood samples were collected at t_0 and t_F in a 2h OGTT and for A1c determination. Changes over the time (t_F-t_0) for MGI (Δ MGI) and for MGL (Δ MGL) were analyzed with generalized estimating equations (GEE) and Bonferroni post-hoc testing; Spearman's correlation between Δ MGL versus Δ 2h OGTT and Δ A1c was tested; descriptive statistics are reported as means \pm SD, means [95% IC] or %.

Results: Twenty subjects (female 50%, obese 75%, mean age 38.8 ± 5.2 years, BMI 31.2 ± 2.2 kg/m²) were randomized. Changes in MGI were not significant between groups over time ($p=0.894$). Although there was a greater reduction in Δ MGL ($p=0.077$) from t_0 to t_F in the AG ($-23.2[-34.8,-11.7]$) versus SG ($-14.2[-20.1,-8.3]$), these changes did not reach statistical differences. The relationship between Δ MGL and Δ 2h plasma glucose (Δ 2hPG) and Δ A1c was statistically significant for AG. While Δ 2hPG and Δ A1c did not vary with changes in Δ MGL for SG ($p=0.848$ and $p=0.172$, respectively), the greater the Δ MGL reduction, the greater the Δ 2hPG and Δ A1c reduction for AG ($r=0.745$, $p=0.021$ and $r=0.727$, $p=0.026$). Both groups had their weight and BMI reduced at t_F , but these changes were not statistically significant.

Conclusion: This preliminary analysis suggests that repetitive active tDCS over the rDLPFC may play an important role for improving glycemic profile by reducing meal's mean glycemic load.

Keywords: tDCS; Glycemic Index; Glycemic Load;