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**Objective:** We hypothesized an increase in dorsolateral prefrontal cortex (DLPFC) glutamate levels would occur after three weeks of repetitive transcranial magnetic stimulation (rTMS) treatment and a decrease in major depressive disorder (MDD) symptoms.

**Method:** We report six cases (four females) 15-21 years of age with treatment-resistant MDD. Participants had a mean age of 18.7 years (SD  $\pm 1.95$ ) and a mean IQ of 102.3 ( $\pm 3.39$ ). Short echo proton magnetic resonance spectroscopy (<sup>1</sup>H-MRS) was used to quantify glutamate levels in the left DLPFC (4.5 cc) before and after rTMS treatment. rTMS was localized to the left DLPFC and applied for 15 consecutive weekdays (120% RMT, 40 pulses over 4 seconds (10 Hz), inter-train interval 26 seconds, 75 trains, 3000 pulses). Treatment response was defined as a greater than 50% reduction in Hamilton Depression Rating Scale scores (Ham-D). <sup>1</sup>H-MRS data was analyzed with LCModel to determine glutamate concentration.

**Results:** Following rTMS, treatment responders (N=4) showed an increase (relative to baseline) in left DLPFC glutamate levels (11%), which corresponded to an improvement in depressive symptom severity (68% Ham-D score reduction). Treatment non-responders (N=2) had elevated baseline glutamate levels compared to responders in that same region, which decreased with rTMS (-10%). Procedures were generally well tolerated with no adverse events.

**Conclusions:** rTMS is feasible and possibly efficacious in adolescents with MDD. In responders, rTMS may act by induced elevations in elevating DLPFC glutamate levels in the left DLPFC, thereby leading to symptom improvement. Transcranial Magnetic Stimulation for Adolescent Depression (TMSAD).