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Letter to Editor

Transcranial Photobiomodulation for Down Syndrome

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To the Editor:

Down Syndrome (DS), as neuropsychiatric condition, is characterized by intellectual disability as well as by emotional and behavioral dysregulation.[1] Unfortunately, to date, the treatment of DS' neuropsychological symptoms scarcely relies on biologically driven interventions, but rather on behavioral, educational, and vocational training, early stimulation therapy, and supportive home environment.

Photobiomodulation (PBM) with near-infrared (NIR) light is a new intervention based on low-level light, delivered noninvasively and transcranially (t-PBM), which penetrates into the brain,[2] and is absorbed by mitochondrial chromophores, boosts brain metabolism,[3] and modulates the cerebral cortex.[4]

Owing to the insufficient response to ongoing standard interventions for DS, parents of a child with DS were offered t-PBM NIR light, by their child's physician (P.M.). They were informed of the possible benefits and adverse effects of such therapy and agreed to its off-label use; minor's assent was also sought. This chart review of children treated with t-PBM was approved by the Institutional Review Board of the Massachusetts General Hospital. This report describes the use of t-PBM in three children with DS (an 8-year-old girl and two 11- and 12-year-old boys), who were treated with either one or two cycles of t-PBM, each consisting of two in-office sessions per week for 4 weeks. t-PBM was started with the Omnilux New U device (Photomedex, Inc.) applied to the forehead. t-PBM was delivered with the following parameters: continuous wave, wavelength 830 nm, irradiance 33.2 mW/cm^2, fluence 40 J/cm^2, treatment window 28.7 cm^2 per site and duration 20 min per site, two sequential sites based on electroencephalography points: F3 and F4 (Fig. 1), and total energy delivered per session 2.3 kJ. All children were evaluated at baseline, as part of their ongoing clinical care, and were assessed every 2 weeks by their physician for safety and tolerability as well as any changes in behavior, cognitive functions, and mood and drawing skills, according to standard clinical practice. t-PBM sessions were well tolerated and neither the children nor their parents reported any adverse experiences. Within weeks of t-PBM, the physician, the parents, and other caregivers noticed behavioral improvements. Although no quantitative measures were implemented, the following qualitative changes were reported: (1) improved dexterity (fine motor skills) was reported by the caregivers and also demonstrated by more accurate copying of drawings (spiral drawing test) and by more detailed portraits' drawings (Fig. 2). (2) Improved verbal fluency (speaking in full sentences) paired with greater attention, suggesting both a motor and procognitive effect of NIR light.[5–7] (3) Noticeable were also the mood and behavioral changes, with less emotional lability, less weeping, less agitation, or physical outbursts.[8] (4) Greater engagement in leisure activities at home—such as watching TV—was reported by the parents, as they noticed their child required less supervision. They described their child as calmer, less hyperactive, more able to relax, and to attend to the activity of the moment. (5) Seasonal upper respiratory infections seemed less likely to occur, according to the parents.[9]

Altogether, in these three cases, t-PBM showed encouraging results as an intervention for DS with seemingly few or no side effects or adverse events. The underlying mechanisms of such clinical improvement and the long-term tolerability and safety of t-PBM in the developing brain remain largely unknown and deserve further study.

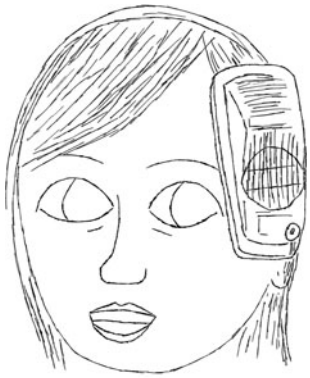

FIG. 1. The picture shows the handheld portion of the Omnilux New U device pressed against the left forehead of the child. Both the right (F4) and the left (F3) sides of the forehead were sequentially treated at each t-PBM session.

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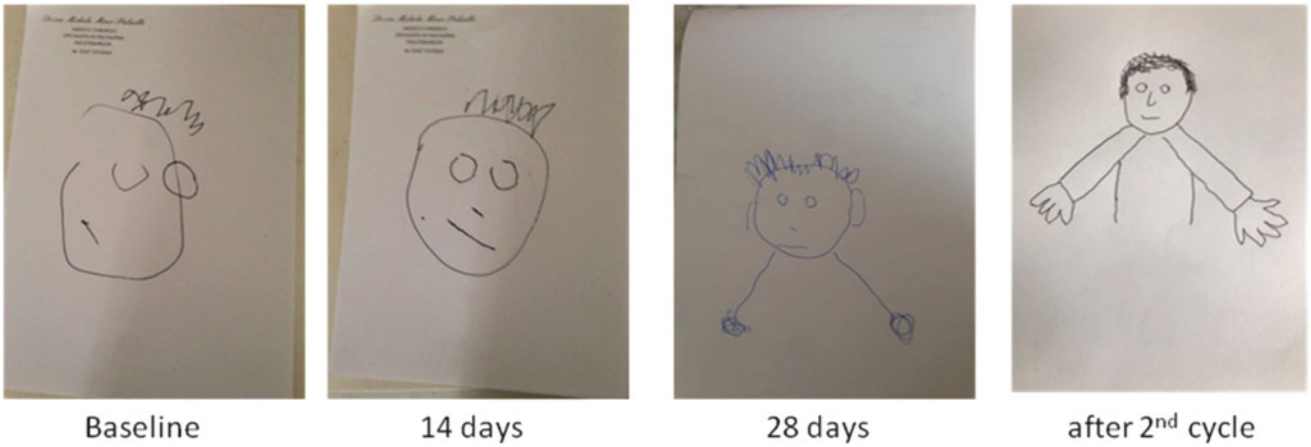

FIG. 2. ''Draw my portrait (your doctor).'' Drawing skills of an 8-year-old girl with Down Syndrome before and after first cycle of t-PBM and after second cycle of t-PBM.

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Authors Disclosure Statement

P.M., M.M., and V.S. have no competing financial interests. Dr. Cassano has received consultation fees from Janssen Research and Development and from Niraxx Light Therapeutics, Inc. Dr. Cassano has received unrestricted funding from Photothera, Inc. and then from Litecure, Inc. to conduct studies on t-PBM for the treatment of major depressive disorder and a study on healthy subjects. He has also received funding from Cerebral Sciences to conduct a study on t-PBM for generalized anxiety disorder. Dr. Cassano cofounded a company (Niraxx Light Therapeutics, Inc.) focused on the development of new modalities of treatment based on NIR light. Dr. Cassano has filed several patents related to the use of NIR light in psychiatry.

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