International Journal of Clinical and Health Psychology (2015) 15, 217–225

International Journal of Clinical and Health Psychology

www.elsevier.es/ijchp

ORIGINAL ARTICLE

Neurofeedback, pharmacological treatment and behavioral therapy in hyperactivity: Multilevel analysis of treatment effects on electroencephalography

Inmaculada Moreno-García[a,*], Gracia Delgado-Pardo[a], Carlos Camacho-Vara de Rey[a], Susana Meneres-Sancho[a], Mateu Servera-Barceló[b]

[a] *Universidad de Sevilla, Spain*
[b] *Universidad de las Islas Baleares, Spain*

Received 13 January 2015; accepted 20 April 2015
Available online 6 June 2015

KEYWORDS
ADHD;
Treatments;
EEG;
Multilevel Analysis;
Experiment

Abstract The purpose of this study was to investigate the efficacy of neurofeedback, pharmacological treatment and behavioral therapy in Attention Deficit Hyperactivity Disorder (ADHD) through a controlled, randomized, multigroup design, with pre-, post- and follow-up treatment phases. The objectives of this study are: a) to analyze individual trajectories over time of each child in treatment, from specific measures of EEG (theta/beta ratio/TBR) considering age and sex and b) to determine the therapeutic effect on attentional and behavioral variables evaluated through the Integrated Visual and Auditory Continuous Performance Test. A total of 57 children (7-14 years) diagnosed with ADHD, were randomly assigned to one of the following experimental conditions: 1) 30 Theta/Beta training sessions, 2) Methylphenidate treatment and, 3) Behavior therapy administered according to a cognitive-behavioral protocol based on manuals. Data were analyzed using a Multilevel Longitudinal Regression Model. Results show that administered treatments are effective and cause similar effects on TBR variable, with no differences between them. However, significant differences were observed in the global attention (p=.002), auditory attention (p=.017) and visual attention (p=.028).

* Corresponding author: Departamento de Personalidad, Evaluación y Tratamiento Psicológico, Universidad de Sevilla, c/Camilo José Cela, s/n, 41018. Sevilla (Spain).
E-mail address: imgarcia@us.es (I. Moreno-García).

http://dx.doi.org/10.1016/j.ijchp.2015.04.003

PALABRAS CLAVE
TDAH;
tratamientos;
EEG;
análisis multinivel;
experimento

Neurofeedback, tratamiento farmacológico y terapia de conducta en hiperactividad: análisis multinivel de los efectos terapéuticos en electroencefalografía

Resumen Se investiga la eficacia del neurofeedback, tratamiento farmacológico y terapia de conducta en el Trastorno por Déficit de Atención con Hiperactividad (TDAH) mediante un diseño multigrupo, aleatorizado y controlado con fases pre, post-tratamiento y seguimiento. Se pretenden los siguientes objetivos: a) analizar las trayectorias individuales a través del tiempo, de cada niño en tratamiento, en la medida del EEG (theta/beta ratio/TBR), considerando edad y sexo, y b) determinar el efecto terapéutico en variables atencionales y conductuales evaluadas mediante el *Integrated Visual and Auditory Continuous Performance Test*. Participaron 57 niños (7-14 años) diagnosticados con TDAH, asignados aleatoriamente a alguna de las siguientes condiciones experimentales: 1) 30 sesiones de entrenamiento theta/beta, 2) tratamiento con metilfenidato y 3) terapia de conducta, según protocolo basado en manuales. Se ha empleado el Modelo Longitudinal de Regresión Multinivel para análisis de datos. Los resultados muestran que los tratamientos administrados son eficaces y originan efectos similares en la variable TBR, no apreciándose diferencias entre los mismos. Si bien, se observan diferencias significativas en la atención global (p=.002), atención auditiva (p=.017) *y* atención visual (p=.028).

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder which essential feature is a persistent pattern of inattention, and/or hyperactivity-impulsivity that interferes with functioning or development (American Psychiatric Association, APA, 2013). Pharmacological treatment is the option that is usually recommended for school-age children and young people with severe ADHD (NICE, 2013). Empirical studies have generally compared the efficacy of pharmacological treatment with other therapy options. With respect to behavioral interventions, So, Leung, and Hung (2008) indicated that the combination of methylphenidate and behavioral therapy was effective in reducing ADHD symptoms and that this combination favors a reduction of the initially prescribed dose of medication and increases parent acceptance of treatment. Sibley, Kuriyan, Evans, Waxmonsky, and Smith (2014) concluded that medication and behavior therapy produce similar range of therapeutic effects on the symptoms of adolescents with ADHD.

Research on non-pharmacological interventions in ADHD treatment has shown that psychological treatments that incorporate behavioral techniques prove effective. Hodgson, Hutchinson, and Denson (2014) replicated the work by Fabiano et al. (2009), corroborating the efficacy of seven non-pharmacological interventions that included behavioral modification, neurofeedback, school programs and parent training. Specifically, there is clear evidence of the effects of parent training, whose interventions should be tried before medication among preschoolers with ADHD and results remain even after intervention ended (Charach et al., 2013). Thus, parent training programs are part of standard treatments for children with ADHD (Storebø, Gluub, Winkel, & Simonsen, 2012), as well as school-based interventions (Evans, Schultz, DeMars, & Daves, 2011). Besides, cognitive- behavioral interventions provide satisfactory results when applied to adolescents with ADHD (Antshel, Faraone, & Gordon, 2014).

In terms of neurofeedback, the statistically significant results in the study by Hodgson et al. (2014) show that this therapeutic option is effective at reducing ADHD symptoms. The debate on the evidence of neurofeedback's efficacy has been of particular interest in the past years (Loo & Makeig, 2012). In these studies, authors have focused on the level of clinical efficacy, which has been determined to be ''Efficacious and Specific'' according to Arns, De Ridder, Strehl, Breteler, and Coenen (2009) and ''Probably Efficacious'' by Lofthouse, Arnold, Hersch, Hurt, and deBeus (2012).

In a study by Duric, Assmus, Gundersen, and Elgen (2012) authors concluded that neurofeedback represents a viable alternative to pharmacological treatment. Following Willis, Weyandt, Lubiner, and Schubart (2011), who reviewed the empirical works published between 2004 and 2010, and the studies published between 1994 and 2010 it is considered that the evidence on the efficacy of neurofeedback is still not conclusive.

Electrophysiological measures were among the first to be used to study brain processes in children with ADHD. Particularly, electroencephalography (EEG) has been used both in research, to describe and quantify the underlying neurophysiology of ADHD, but also clinically, in the assessment, diagnosis (González-Castro, Rodríguez, López, Cueli, & Alvarez, 2013) and treatment of ADHD. Increased theta/beta ratio (TBR) has show to be a sensitive marker of ADHD (Monastra, Lubar, & Linden, 2001) and correlates strongly with age-related changes in ADHD behavioral symptomatology overtime (Snyder & Hall, 2006). Given the excess of theta and decreased beta activity observed among children with ADHD, it is easy to understand that altering these parameters through treatment would result in improvements in ADHD symptoms.