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Review article

Clinical significance of neuropsychological improvement after supplementation with omega-3 in 8–12 years old malnourished Mexican children: A randomized, double-blind, placebo and treatment clinical trial

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ABSTRACT

It has been shown that supplementation with omega-3 improves cognitive performance, especially in infants and toddlers, but it is unknown whether these results are effective in older malnourished children. The aims of this study, therefore, were to investigate the omega-3 supplementation effects in 8- to 12-year-old children and to know which neuropsychological functions improve after three months of intervention in a sample of Mexican children with mild to moderate malnutrition. This study was a randomized, double-blind, treatment and placebo study of 59 children aged 8–12 years who were individually allocated to 2 groups. The duration of the intervention lasted 3 months. Neuropsychological performance was measured at baseline and at 3 months. Results show that more than 50% of children in the treatment group had greater improvement in 11 of the 18 neuropsychological variables studied. Processing speed, visual-motor coordination, perceptual integration, attention and executive function showed improvement in more than 70% of the omega-3 supplemented children. This trial was registered at clinicaltrials.gov as NCT01199120.

Contents

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1. Introduction

Malnutrition is one of the most important nutritional issues during childhood because it is in the first years of life when growth is intensive and there is still ripeness of diverse organs. Therefore, the longer malnutrition lasts in a young child the consequences will be more serious (Pollitt, 2000). Malnutrition in children is the result of a poor diet, which is related to diverse biological, socioeconomic, and cultural factors (Rivera & Sepúlveda, 2003; Wachs, 2000; Zlotkin, 2006). At long term, malnutrition can result in damage of cognitive functions and academic performance (Grantham-McGregor, Cheung, Cueto, Glewwe, Richter, & Strupp, 2007). In addition, in socio-economical terms, poor countries are the most affected by the ravages of malnutrition, and this hampers their development (Branca, 2006).

The main nutritional deficiencies studied in children lie in the protein-energy, iron and essential fatty acids deficiency (Tofail et al., 2008; Walker, Chang, Powell, & Grantham-McGregor, 2005; Yehuda, Rabinovitz, & Mostofsky, 2006); and many of these researches tend to focus on the first two years of life, because it is believed that the brain develops intensively during those years (Benton, 2008). Nevertheless, researchers have recently concluded that brain maturation has not been completed at this stage and, in addition, its development is not uniform (Branca, 2006); on the other hand, brain development continues along infancy, during childhood, and up to adolescence (Ito, 2004; Romine & Reynolds, 2004). Therefore, cognitive and academic deficits in malnourished children during early childhood continue in late adolescence (Walker et al., 2005). Because of this, it is necessary to research nutrition issues during posterior ages (Benton, 2008).

Essential fatty acids (EFA) play an important role in learning faculties and behavior (Johnson, Ostlund, Fransson, Kadesjö, & Gillberg, 2009; Yehuda, Rabinovitz, & Mostofsky, 2005). Omega-3 (ω-3), is a particularly important EFA, its deficiency causes a significant reduction of catecholamine, which affects the transportation and usage of glucose by the brain (Yehuda et al., 2006). Omega-3 is composed by docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). DHA is a component of cerebral gray matter (Innis, 2007) particularly concentrated in synaptic nerve cells, where it seems to be involved in the signaling processes between neuronal cells (Youdim, Martin, & Joseph, 2000), controlling the activity of neurotransmitters and the neuronal growth factors (Yehuda, Rabinovitz, Carasso, & Mostofsky, 2002). Although the statement is controversial (Hirayama, Hamazaki, & Terasawa, 2004), it seems that DHA is crucial for normal cognitive functions (Sinn & Bryan, 2007). Any deviation of physiological levels of DHA is associated with cognitive impairment (Yehuda, Rabinovitz, & Mostofsky, 1999) and with some developmental disorders such as attention deficit disorder, autism, and motor problems (Johnson et al., 2009; Raz & Gabis, 2009; Richardson & Ross, 2000; Sinn & Bryan, 2007). Overall, these variables could impact learning performance (Branca, 2006).

Studies addressing Omega-3 supplementation to improve cognitive skills are focused in infants and in early childhood (Helland, Smith, Saarem, Saugstad, & Drevon, 2003; Innis, 2007; Merwe et al., 2013). In brief, these studies found that the supplementation improves the cognition in general. On the other hand, most of them use the statistical but not the clinical significance of participant improvements to compare supplemented and non-supplemented groups (Fontani, Corradeschi, Felici, Alfatti, Migliorini, & Lodi, 2005; Kennedy et al., 2009). This fact is becoming important to understand the clinical relevance of interventions (Atkins, Bedics, McGlinchey, & Beauchaine, 2005; Fethney, 2010; Hurst & Bolton, 2004; Man-Son-Hing et al., 2002).

In summary, most studies are characterized by: (1) making the intervention in children under 5 years of age (Innis, 2007; Parra-Cabrera, Moreno-Macias, Mendez-Ramirez, Schnaas, & Romieu, 2008); (2) not making a detailed assessment of the neuropsychological functions that continue to develop at later ages (Benton, 2008; Walker et al., 2005), and (3) not considering the clinical significance of results. Therefore, the objective of this paper is to investigate the ω-3 supplementation effects in 8- to 12-year-old children and to know which neuropsychological functions improve after 3 months of intervention in a sample of Mexican children with mild to moderate malnutrition. We hypothesize that the intervention group will get clinically relevant improvements in the functions related to memory and executive function.