Research in Developmental Disabilities 37 (2015) 102–111

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Predictors of participation change in various areas for preschool children with cerebral palsy: A longitudinal study

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ARTICLE INFO

Article history:
Received 24 July 2014
Received in revised form 9 November 2014
Accepted 9 November 2014
Available online 27 November 2014

Keywords:
Cerebral palsy
Predictor
Participation
Preschool children
Longitudinal study

ABSTRACT

This study identifies potential predictors of participation changes in various areas for preschool children with cerebral palsy (CP). Eighty children with CP (2–6 years) were enrolled. Seven potential predictors were identified: age; sex; socioeconomic status, CP subtype; cognitive function, Function Independence Measure for Children (WeeFIM), and motor composite variable from 5 motor factors (gross motor function classification system (GMFCS) level; bimanual fine motor function level; selective motor control score; Modified Ashworth Scale score; and Spinal Alignment and Range of Motion Measure). Outcome was assessed at baseline and at 6-month follow-up using the Assessment of Preschool Children's Participation (APCP) including diversity and intensity scores in the areas of play (PA), skill development (SD), active physical recreation, social activities (SA), and total areas. Dependent variables were change scores of APCP scores at baseline and 6-month follow-up. Regression analyses shows age and sex together predicted for APCP-total, APCP-SD diversity and APCP-total intensity changes ($r^2 = 0.13–0.25$, $p < 0.001$); cognitive function and WeeFIM were negative predictors for APCP-SA and APCP-PA diversity changes, respectively. CP subtype, motor composite variable, and socioeconomic status predicted for APCP changes in some areas. Findings suggest that young boys with poor cognitive function and daily activity predicted most on participation changes.

1. Introduction

Manifestations of cerebral palsy (CP) include spasticity, loss of selective motor control (SMC), muscle weakness, and limited range of motion (ROM), which further limit performance at activities of daily living (ADL) and participation in various activities (Calley et al., 2012; Engel-Yeger, Jarus, Anaby, & Law, 2009). Participation of CP children in skill-based, community-based, and active physical activities is low (Majnemer et al., 2008). For instance, preschool children with CP with poor motor function participated less in activities than those with good motor function (Law, King, Petrenchik, Kertoy, & Anaby, 2012).

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http://dx.doi.org/10.1016/j.ridd.2014.11.005
0891-4222/

Potential predictors, such as age, sex, environmental factors, body function, and activity limitation, for children and youth with CP, have been proposed to be linked to participation in leisure activities (Shikako-Thomas, Majnemer, Law, & Lach, 2008). High physical ability, young, and female are associated with higher intensity of participation in 205 children with CP aged 13–21 years (Palisano, Orlin et al., 2011). Gross Motor Function Classification System (GMFCS) levels are related to participation for children and youth with CP (Brunton & Bartlett, 2010; Palisano et al., 2009; Palisano, Orlin et al., 2011). The GMFCS level and bimanual fine motor function (BFMF) level are associated with participation for children with CP aged 5–8 years (Beckung & Hagberg, 2002). Physical independence and performance in the mobility domains have predicted well by movement and manual ability of children with CP aged 6–12 years (Morris, Kurinczuk, Fitzpatrick, & Rosenbaum, 2006). The CP subtype is related to participation level for children and adolescents with CP (Fauconnier et al., 2009; Kerr, Parkes, Stevenson, Cosgrove, & McDowell, 2008; Schenker, Coster, & Parush, 2005).

Bartlett and Palisano proposed a model on determinants for motor changes in children with CP. This model targets on the relationships among child characteristics (*e.g.* temperament, personality, and cognitive impairments), family ecology, and health care services (Bartlett & Palisano, 2000). Temperament patterns varied among different CP subtypes (Chen et al., 2011) and may further influenced their participation. The cognitive impairments and acitivities of daily living (ADL) limitations were associated with participation in children and adolescents with CP (Fauconnier et al., 2009; Law et al., 2012; Majnemer et al., 2008). The environmental factors, such as socioeconomic status and family factors, were also associated with participation in children or youth with CP (Chan, Lau, Fong, Poon, & Lam, 2005; Colver et al., 2012; Law et al., 2012; Mihaylov, Jarvis, Colver, & Beresford, 2004; Shikako-Thomas, Shevell, Schmitz et al., 2013). Since most studies examined participation intensity for school children and adolescents with CP, knowledge on preschool participants are therefore limited.

A 3-year follow-up study indicated that factors associated with change in participation intensity were depended on activity type, sex and age for 402 children/youth with physical disabilities (King et al., 2009). Wright et al. reported poor-to-fair relationships between measures of body function and structure, activity, and participation for CP children who were injected with botulinum toxin type-A (Wright, Rosenbaum, Goldsmith, Law, & Fehlings, 2008). Activity and participation gains following injection are likely influenced by environmental factors, GMFCS level, or age for ambulatory children with spastic CP (Wright et al., 2008). Another 2-year study followed on children with CP aged 9–15, indicated that muscle strength, involved limb distribution, SMC, ROM, and spasticity measured by the modified Ashworth scale (MAS) were linked to gross motor function measure (GMFM) score corrected by GMFCS level (Voorman, Dallmeijer, Knol, Lankhorst, & Becher, 2007). A 6-month follow-up study showed that GMFCS level and age are robust negative predictors for change in most developmental domains, such as cognition, language skills, motor function, social function, and self-help in preschool children with CP (Chen, Hsu, et al. 2013). The Spinal Alignment and Range of Motion Measure (SAROMM) (Bartlett & Purdie, 2005) was a negative predictor for cognitive change (Chen, Hsu, et al. 2013). Relationships between potential predictors and participation change are complex; however, few studies have investigated the relationship between potential predictors and participation change in various activities for preschool children with CP.

Clinical demand is increasing for valid and responsive participation measures for preschool children to assess participation improvement and justify intervention. The Assessment of Preschool Children's Participation (APCP) (Law et al., 2012) assesses the level of activity participation for preschool children aged 2–6. Subset data from this study used to determine the clinimetric properties of APCP have already been published (Chen, Chen, et al. 2013), showing that APCP score was markedly responsive to change at follow-up (Chen, Chen, et al. 2013). That is, the clinimetric properties of the APCP measure makes it an appropriate and valid tool to identify participation patterns in terms of diversity and intensity of various activities for preschool children with CP (C.L. Chen, Chen, et al. 2013).

This study, attempts to identify potential predictors that can predict participation change in various areas for preschool children with CP. The APCP was selected as the participation measure in this study. This scale contains both diversity and intensity scales in the areas of play (PA), skill development (SD), active physical recreation (AP), and social activities (SA). Potential predictors tested in this study were age, sex, socioeconomic status, CP subtype, cognitive function, motor composite variable (GMFCS level, BFMF level, SMC score, spasticity score, and SAROMM), and ADL. We hypothesize that different predictor combinations can predict participation change (diversity and intensity) in different areas for children with CP.

2. Materials and methods

2.1. Participants

Children with CP were recruited from rehabilitation clinics at three hospitals. A physiatrist and a physical therapist independently determined eligibility for inclusion for each participant. The inclusion/exclusion criteria were reported in our previous manuscript (Chen, Chen, et al. 2013). Inclusion criteria were diagnosis of CP and age 2 years to 5 years and 11 months. Children with a progressive neurological disorder, genetic or metabolic disorder, or severe concurrent illness or disease (*e.g.*, active pneumonia or brain tumor) were excluded. Each participant was re-examined at 6 months after the initial assessment. The physiatrist confirmed the CP diagnosis, CP subtype and limb distribution based on history taking, physical examination, chart review, or brain imaging findings. Five participants were lost during follow-up for the 85 children that were initially recruited using convenience sampling (*i.e.*, 1 due to active medical problems, 1 due to death, and contact with