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The intra- and inter-rater reliability of component analysis of rise from supine in the children with typical development and developmental delay

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ABSTRACT

The purpose of this study was to determine the intra- and inter-rater reliability of classifying the movement patterns of rising from supine to stand in the children with typical development (TD) and mild to moderate developmental delay (DD). Sixty-eight children with TD and 20 children with DD aged 2 through 6 years were videotaped during rising. Two trained pediatric physical therapists independently viewed each videotape and classified the movement patterns of upper extremities (UE), trunk/axial (AX) and lower extremities (LE) regions using descriptive categories developed by previous researchers. Kappa statistic and average percentage of agreement were calculated to determine reliability. The average agreement rate of intra-rater ranged from 90% to 97% in TD group for three regions, and 79% to 89% in DD group; the agreement rate between raters ranged from 82% to 95% in TD group for three regions, and 71% to 87% in DD group. Using kappa statistic guidelines, high intra- and inter-rater reliabilities ($k > 0.81$) were found in TD group, except inter-rater reliability for LE. Substantial intra- and inter-reliabilities ($0.61 < k < 0.81$) were found in DD group. As comparing the reliabilities of three regions, the lowest intra- and inter-rater reliabilities were found at the LE region in both groups. As taking age into consideration and dividing each group into subgroups by 2-year interval, in DD group, the intra-rater reliabilities were higher in younger participants (aged 2-4 years), except for the LE region, but the results of inter-rater reliabilities were variable. For the children with TD, the levels of inter-rater reliability increased for the UE region and decreased for LE region in older age, but the results for these two regions were reverse for the children with DD. The findings of this study suggested that the complexities and difficulties affecting reliabilities in classifying the movement patterns of rising were related to developmental capability, age and body region. In order to improve intra- and inter-rater reliabilities, extra training is needed in examining the children with DD, particularly for the UE and LE regions.

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1. Introduction

The therapists working with the children with developmental delay (DD) consider the abilities to rise from the floor as an essence in assessment and training of motor developmental function. One of the important issues concerning movement

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patterns to rise up is developmental progression since this functional task involves many prerequisites, including appropriate postural tone and righting behaviors which hold practical and theoretical significance for physical and occupational therapists, and thus should be appropriately evaluated. It is essential for the related professionals serving the children with DD to inspect what movement patterns the children use with the expectation that the knowledge would bring about more effective training of this task.

Heriza (1991) has suggested that there is a need to develop evaluation tools that look into the "process of movement change" since developmental milestones usually examine the acquisition of a task, and do not characteristically depict the movement patterns used to accomplish the task. The process of movement change is expected to be detected by using "component analysis", a method that breaks body action down into constituent parts and then describes movement within these specific body regions. Previous researchers using component analyses also propose that the various movement patterns demonstrated by the individual represent different steps of developmental sequences for the body regions (Belt et al., 2001; Marsala & VanSant, 1998; Unrau, Hanrahan, & Pitetti, 1994; Vansant, 1988a, 1990). Although computerized motion analysis systems have been used widely in laboratories to analyze movement patterns, the extensive budget and labor required for the system and process makes it impossible to employ the methods in clinical settings. Component analyses by observation hold practical significances, but require certain levels of consistence between repeated tests and consensus between raters before being applied in clinics.

For rising from supine to stand, a component approach using the descriptive categories to portray movement patterns of the upper extremities (UE), trunk/axial regions (AX), and lower extremities (LE) was first developed by Vansant (1988b) and used to describe young adults' movements. Originally, five categories for UE and four categories for AX and LE regions were identified to describe the rising patterns. For the young children aged 4-7 years, two new categories (one for AX, one for LE) were added, and some original descriptive categories were broadened to include some variations not observed in young adults (Vansant, 1988a). Since then, this method to describe movement patterns of independent rising has been applied to the middle-aged adults with or without disabilities (Green & Williams, 1992), healthy and normal toddlers (Marsala & VanSant, 1998), and the elderly (Alexander, Ulbrich, Raheja, & Channer, 1997; Hofmeyer, Alexander, Nyquist, Medell, & Koreishi, 2002; Ulbrich, Raheja, & Alexander, 2000). The descriptive categories have also been used in the children and adults with neuromuscular involvement (Belt et al., 2001; Boswell, Gryder, & Stavrakos, 1993; Mewasingh et al., 2002, 2004; Unrau et al., 1994), and young adults with ankle constrained by solid ankle-foot orthoses (King & Vansant, 1995).

When examining primitive reflexes and volitional movement of infants and toddlers, performing analyses through observation of the child's movement have been found to have higher the intra- and inter-rater reliabilities than through the methods requiring to handle the child (Stuberg, White, Miedaner, & Dehne, 1989). It may denote the advantage of administering component analysis to children since the analyzing process is also through observation, not handling. However, when using the methods through observation, reliability between raters and percentage of exact agreement on repeated classifications are particularly important, since the analyses are completely relied on the raters (Green & Williams, 1992; Marsala & VanSant, 1998; McCoy & Vansant, 1993; Vansant, 1988a, 1988b).

Marsala and VanSant (1998) tested whether the categories developed by Vansant (1988a) for young children were appropriate to describe the movement patterns of the typically developing toddlers aged from 15 to 47 months. They revised one category in axial region to demonstrate more trunk rotation of the toddlers than young children, and added two new categories to the LE region. Using these modified movement pattern descriptors to classify 50 randomly selected trials, the agreement rate of intra-rater was 96%, 86% and 96% for the UE, AX and LE, respectively; the agreement rate between two raters was 94%, 90% and 96% for the UE, AX and LE, respectively. Belt et al. (2001) applied the same categories to observe 9 subjects with Prader–Willi syndrome aged 7-36 years and age-, weight- and gender-matched healthy control group. They made minor modifications to categorical descriptors in order to evaluate the participants with Prader–Willi syndrome. The intra-rater's agreement rate on 30 random trials for three regions ranged from 93% to 100%, and of inter-rater's ranged from 93% to 97%; the intra-rater and inter-rater reliability derived from kappa statistics was between 0.82 and 1.00, and between 0.91 and 0.95, respectively. Both studies had high intra- and inter-rater reliabilities. However, the former did not investigate the children with DD and the latter did not clearly state whether the trials were selected from control or experimental group.

No study has been conducted to establish the intra- and inter-rater reliability levels of component analyses for rising task on young children with DD, although these children are the most common populations treated in clinics. Since observational data may be classified inaccurately due to many factors, such as expectation bias, coding system complexity, behavior predictability, behavior valence, and influence of extraneous cues etcetera (Harris & Lahey, 1982), there is a need to establish the reliabilities of component analyses for rising in the young children with DD before investigating precise forms of the movement patterns. The purposes of this study were to determine the agreement rate and the inter- and intra-rater reliability for the three body regions (UE, AX, and LE) of the young children with mild to moderate DD as compared with the children with typical development (TD).

2. Materials and methods

2.1. Participants and instruments

This study was conducted at the Function and Motor Development Research Laboratory in Physical Therapy Department of a National University and Rehabilitation Department of the University Hospital.