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The movement patterns used to rise from a supine position by children with developmental delay and age-related differences in these



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ABSTRACT

The purposes of this study were to determine (1) movement patterns and strategies of children with mild to moderate developmental delay (DD) used to rise up and how they differ from those used by age-matched children with typical development (TD), (2) whether the movement patterns differ with age in children with DD, and (3) to determine the developmental sequences for the UE, AX and LE in children with DD and whether they are different from those used by children with TD. Sixty six children with TD and 31 children with DD aged two to six years were recruited. Peabody Developmental Motor Scale II (PDMS-2) was used to determine the motor performance level. The participants were recorded during rising for at least five repetitions. Two trained pediatric physical therapists viewed each video recording and classified the movement patterns of the upper extremities (UE), trunk/axial (AX) and lower extremities (LE) regions using descriptive categories developed by previous researchers. The DD and TD groups were further divided into four subgroups each using a one-year interval. The percentage of occurrence of the each UE, AX and LE movement was determined and compared across subgroups, and between each age-matched pair of TD and DD groups. The results demonstrated that the participants in the TD group clearly followed the proposed developmental sequence and the children with DD followed the developmental sequences but with different maturation speeds and greater variability, especially at the age of three to five years. The most common movement patterns used by the children in each of the DD subgroups were at least one developmental categorical pattern behind those used by the age-matched children with TD before five years old, except for the LE region. In the DD group, the movement patterns had moderate to high correlation with the child's motor performance level, indicating that the children with better motor performances used more developmentally advanced patterns in comparison with those with lower scores. However, besides motor maturity, numerous other intrinsic/extrinsic factors may affect the child's performance of this task. The information obtained in this study would assist therapists when working with the children with DD, so that they can provide individualized treatment rather than guiding all such children toward a single, mature pattern.

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1. Introduction

From a practical viewpoint, moving from a supine to a sitting position, or rolling over to a prone position, and then standing up, are manifestations of physical independence which are based on muscle strength, flexibility and postural control involving automatic reactions. Therapists working with children with developmental delay (DD) thus consider the ability to rise from the floor as very important in the assessment and training of motor functions. When teaching children with DD to rise from a supine position, therapists may prescribe specific rising movement patterns that are seen in children with typical development (TD). However, few studies have examined whether the rising movement patterns of children with DD or their developmental progression are the same as those of children with TD, particularly for those at a young age below seven years.

Previous studies usually describe rising movement based on the movements of the upper extremities (UE), trunk/axial regions (AX) and lower extremities (LE), a method originally developed by VanSant (1988b) for young adults. Component approach is a method which breaks down the actions of the overall body into constituent regions and then describes movements within these. This method, either with or without modification, has been applied to describe the rising movement patterns of the healthy individuals of different ages, such as middle-aged adults (Green & Williams, 1992), typically developing toddlers (Marsala & VanSant, 1998), and the elderly (Alexander, Ulbrich, Raheja, & Channer, 1997; Hofmeyer, Alexander, Nyquist, Medell, & Koreishi, 2002; Ulbrich, Raheja, & Alexander, 2000), as well as people with neuromuscular involvement (Belt et al., 2001; Boswell, Gryder, & Stavrakos, 1993; Mewasingh et al., 2002, 2004; Unrau, Hanrahan, & Pitetti, 1994), and young adults with their movements constrained by solid ankle-foot orthoses (King & VanSant, 1995).

In children with TD aged four to seven years old, the most common rising movement patterns include moving the trunk forward with some rotation, an asymmetrical push pattern with the upper extremities, and an asymmetrical or wide-based squat pattern (VanSant, 1988a). Based on their observations, VanSant placed the categorical descriptors of the UE, AX and LE in a developmental sequence, with higher scores reflecting a higher developmental age. However, the movement categories defined by VanSant (1988a) for the UE and AX regions were later revised for younger toddlers, aged 15–47 months, and two new categories for the LE region were added to describe the patterns not observed in older children (Marsala & VanSant, 1998). Since these two new patterns of the LE are the most common ones seen in the younger children, they are considered as the earliest developed movements. The most common movement patterns of the UE, AX and LE in children aged 15–47 months are “push and reach to bilateral push”, “full rotation, abdomen down” and “full rotation, and abdomen up”, and “Pike” (extended legs with the hips greater than the height of the shoulders), respectively. When dividing the subjects into subgroups by age (15–25, 26–36 and 37–47 months), each was found to have its own predominant pattern. These findings demonstrate that this method can be used to identify the developmental progression and maturation of various movement patterns for each region of the body.

Several researchers have applied the descriptive categories developed by VanSant (1988a) and Marsala and VanSant (1998) to describe the rising movement patterns of children with mild to moderate spastic diplegic or hemiplegic cerebral palsy (Boswell et al., 1993; Mewasingh et al., 2002, 2004). Boswell et al. (1993) found the level of involvement (mild or moderate) and topographical classification (hemiplegia or diplegia) were related to rising movement patterns in hemiplegic and diplegic children aged four to seven years, and thus suggested the expansion of three categories in the UE and AX regions and the addition of one category to the LE when describing the rising movement patterns of such children. The variability among trials or individuals in the children with cerebral palsy was less than that seen among typically developing children, and only small number of the former demonstrated a stereotyped movement not included in previously described patterns (Mewasingh et al., 2002, 2004).

Besides children with neuromuscular involvement, those diagnosed as DD are the main population that requires therapeutic intervention in early childhood. Unrau et al. (1994) investigated the rising movement patterns of 15 adults with Down's syndrome, and reported that 64% of the UE patterns, 14.6% of the AX patterns, and 33.8% of the LE movements could not be categorized according to VanSant (1988b) original descriptions for normal young adults, and thus more accurate or comprehensive descriptors for movement patterns are needed for this population. Belt et al. (2001) applied Marsala and VanSant's (1998) categories and observed nine subjects with Prader–Willi syndrome aged 7–36 years, and found that they utilized less advanced asymmetrical rising movement patterns, took a longer time to rise, and demonstrated less within-individual variability than a group of controls. They thus concluded that the categorical descriptors required minor modifications in order to evaluate subjects with Prader–Willi syndrome, who usually demonstrate global developmental delay during childhood, as well as hypotonia, obesity and intellectual deficits.

However, to date few studies have aimed to describe the precise movement patterns used to rise from a supine to standing position by young children with DD, and how these differ from those used by children with TD. More information is needed with regard to this, so that better interventions can be carried out to help this population. The purposes of this study were thus as follows: (1) to determine the movement patterns and strategies that the children with DD used to rise up and how they differ from those used by children with TD; (2) to find out whether these movements differ among children with DD of different ages; and (3) to obtain the developmental sequences for the UE, AX and LE in children with DD, and assess whether these are different from those seen in children with TD.

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