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Sensorimotor function in preschool-aged children with expressive language disorder

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ABSTRACT

Aim: The aim of the study was to evaluate functional motor performance and haptic object recognition in 5-year-old children with mild expressive language disorder (ELD) in comparison with age- and gender-matched healthy children.
Methods: The subjects were classified by speech-language pathologist using *The Reynell Developmental Language Scales III* and *Boehm Test of Basic Concepts: Preschool* as children with mild ELD ($n = 29$, incl. 23 boys and 6 girls) and children with typical language development as controls ($n = 29$, incl. 23 boys and 6 girls). The children were examined for manual dexterity, ball skills, static and dynamic balance by *Movement-ABC*, haptic object recognition (HOR), hand-grip strength (HGS) and vertical jumping performance.
Results: Children with mild ELD demonstrated significantly higher scores (i.e., inferior performance) in all subtests of *M-ABC* (all p values <0.05), in haptic object recognition ($p < 0.01$) and vertical jumping height ($p < 0.05$) compared to controls. However, no statistically significant differences ($p > 0.05$) emerged from HGS. Boys with mild ELD demonstrated higher results in impairment score ($p < 0.001$), ball skills ($p < 0.01$) and balance ($p < 0.01$) of *M-ABC*, as well as in HOR ($p < 0.05$). Girls with mild ELD showed higher impairment score ($p < 0.05$) with lower percentile ($p < 0.05$) in *M-ABC*, indicating inferior motor performance, and lower HGS for the non-dominant hand ($p < 0.05$). Seven out of 29 (24.1%) children with mild ELD had definite or borderline motor difficulties, while only one child in control group (3.4%) demonstrated borderline motor difficulties.
Conclusions: Children with mild expressive language disorder do not perform as well as controls in tests of functional motor skills, but their results in tests demanding maximal muscle force generation are in level with typically developing children. Boys and girls with mild ELD demonstrated higher impairment scores in *M-ABC*, indicating the need to follow their overall development more closely.

1. Introduction

Specific language impairment (SLI), also known as developmental speech and language disorder (DSLD), occurs in 6.3% of children with the male rate approximately double in comparison of female rate (Pinborough-Zimmerman et al., 2007). SLI involves delays or deficits in expressive or receptive language development, or both, in the absence of observed mental

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retardation, hearing loss, environmental deprivation or neurological disorders (Leonard, 1998; Tomblin et al., 1997). In case of isolated expressive language disorder (ELD) children may have small vocabularies; they use short, incomplete sentences and produce confusing or disorganized conversations (Johnson, 2007). Girls predominate in expressive–receptive problems, while boys predominate in expressive language and oral-motor problems (Selassie, Jennische, Kyllerman, Viggedal, & Hartelius, 2005).

There is a considerable evidence suggesting that children with SLI experience varying degrees of fine (e.g., cutting with scissors, peg moving, bead threading, finger tapping) and gross motor (e.g., toe gate, walking in a straight line, static balance, hopping, jumping forward on both feet) deficit (Finlay & McPhillips, 2013; Iverson & Braddock, 2011; Rechetnikov & Maitra, 2009; Visscher, Houwen, Scherder, Moolenaar, & Hartman, 2007; Vukovic, Vukovic, & Stojanovik, 2010; Webster et al., 2006). According to different authors the prevalence of motor dysfunction in children with SLI varies from about 34 to 90% (Pieters et al., 2012; Rechetnikov & Maitra, 2009). Vukovic et al. (2010) discovered that children with SLI are delayed in the development of motor skills requiring coordination of legs and arms, as well as the ability to imitate movements. Also Hill (2001) interpreted the lower motor and language skills in children with SLI as an underlying neurological immaturity.

Although force-generation capacity of skeletal muscles is an important indicator of neuromuscular functioning and it is essential for performing different daily activities (Damiano & Abel, 1996), previous studies have dealt this area only briefly. It has been shown that the hand-grip strength and muscle strength of leg extensors in boys with ELD is weaker compared to typically developing boys (Müürsepp, Aibast, & Pääsuke, 2011). Data considering the maximal voluntary muscle strength in girls with ELD is insufficient.

Visscher et al. (2010) discovered in their study about distinguishing the existence of motor impairments between school-aged boys and girls with DSLD, that object control skill deficiencies were more extensive for girls than boys (Visscher et al., 2010). They also showed that children with language disorders performed better in object control tasks than children with speech disorders (Visscher et al., 2010) and children with receptive disorders have better motor performance than children with combined expressive and receptive language disorders (Visscher et al., 2007).

Researches have also shown that SLI is often accompanied by non-linguistic cognitive deficits, including perceptual deficit (Ullman & Pierpont, 2005). Haptic perception is a complex ability requiring adequate cutaneous and kinaesthetic information, hand-movement patterns and cross-modal haptico-visual transfer (Bushnell & Baxt, 1999; Lederman & Klatzky, 1998). The study of Montgomery (1993) reported that children with SLI perform more poorly in HOR tasks than their typically developing peers. Data of our pervious study (Müürsepp, Aibast, Gapeyeva, & Pääsuke, 2012) revealed that the haptic perception in children with mild ELD is considerably more affected than in children with articulation disorder compared to controls. Unfortunately, data about haptic perception in children with SLI is still insufficient especially concerning differences between genders or specific types of SLI.

The majority of previous studies have recruited children with DSLD from clinics or special schools (Finlay & McPhillips, 2013; Iverson & Braddock, 2011; Visscher et al., 2007; Vukovic et al., 2010; Webster et al., 2006), but their impairment severity or type of dysfunction has in most cases remained unspecified. On the other hand, it has been shown that motor function impairment correlates strongly with the observed severity of the child's language disorder (Webster et al., 2006), e.g., the more severe is language disorder, the more pronounced is motor deficit. Nevertheless, it is still very little known how mild ELD can affect functional motor performance and perception of preschool-aged boys and girls.

The purpose of this study was to examine functional sensorimotor abilities in children with mild ELD compared to typically developing children. Furthermore, as previous studies have not distinguished subjects by gender, the present study identified the existence of sensorimotor dysfunction separately in groups of boys and in groups of girls.

2. Materials and methods

2.1. Participants

The participants were recruited from 7 ordinary kindergartens of Tartu, Estonia. Organizers of the study excluded the recruitment of children from special squads or kindergartens for children with severe speech and language disorders or problems in mental or physical development. Speech and language therapists working at the kindergartens were asked to provide a sample of children with language impairment from their workload. The speech therapists produced a list of 62 children aged 5–6 years who had expressive oral language problems. All these 62 children underwent assessment of language skills by *The Reynell Developmental Language Scales III* (Edwards et al., 1997) and *Boehm Test of Basic Concepts: Preschool* (Boehm, 2008) administered by professional speech-language pathologists from the University Clinic of Tartu. A deviation of $\geq$1 SD below the age standards in language tests was used as cut-off for mild speech-language impairments. Of the 62 children, 6 children (5 boys and 1 girl) were excluded because they scored below $\geq$1.5 SD in language tests, referring to moderate speech-language impairments and 27 children (20 boys and 7 girls) were excluded because of the occurrence of oral motor problems only. There were no children with combined type (receptive–expressive) language disorder. Control group (CG) children were randomly selected from the same kindergartens and matched according to age- and sex (23 boys and 6 girls). These 29 CG children also went through language assessments to confirm typical language development. All 58 children included in our study were confirmed to be developing