Journal of Pediatric Urology (2014) 10, 880—885

Journal of Pediatric urology

Sensory processing differences and urinary incontinence in school-aged children

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Received 12 May 2013; accepted 3 January 2014
Available online 6 February 2014

KEYWORDS
Sensory processing;
Pediatric urology;
Urinary incontinence;
Short sensory profile;
Dysfunctional voiding

Abstract *Objective:* Urinary Incontinence (UI) is a common problem among school-aged children (5—11 years). Symptoms such as urgency, diminished awareness of wetting, or apparent apathy may represent differences in sensory processing (SP). This study aims to describe the SP abilities of incontinent school-aged children with typical development to determine if they differ from established norms for continent children.
Materials and methods: The SP abilities of 209 school-aged children with UI were evaluated using the short sensory profile (SSP), a judgment-based caregiver questionnaire, then compared with established norms using descriptive and inferential statistics.
Results: Forty-four percent of children showed significant differences in global SP with the greatest differences noted in tactile sensitivity. Higher section subscores were also noted in "seeks sensation/under responsive" and "auditory sensitivity". Children with dysfunctional voiding (DV) were more likely to show global differences ($p = 0.015$), differences in "seeks sensation" ($p = 0.006$), and auditory sensitivity ($p = 0.041$). The odds for low tactile sensitivity scores were five times greater for children with UI and DV ($p = 0.006$).
Conclusion: These results suggest that differences in SP may be found among typical school aged children with UI. Continued research is indicated to understand the significance of the study results.

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http://dx.doi.org/10.1016/j.jpurol.2014.01.002

Introduction

Many school-aged children have problems with urinary incontinence (UI). This complaint has a reported prevalence range of 6.3—15.0% for all children [1,2]. Caregivers often bring their children for clinical evaluation citing their child's indifference to being wet or poor motivation for change, while the child may counter by describing an apparent lack of urge, sudden urgency, or failure to recognize being wet. Both caregivers and children use language that describes sensation, and both imply that the child with UI seems to have differences in the perception of bladder fullness, bladder emptying, or the ability to act on this perception in a timely manner. However, these otherwise healthy children appear to differ in their perception of fullness in comparison with continent peers, with apparent difficulty with sensory registration. It would appear reasonable to evaluate the sensory processing (SP) abilities of children with UI to determine if there are, indeed, significant differences.

SP is an expansive term that refers to the ability of the central nervous system (CNS) to interpret sensory information [3,4]. SP should not be confused with sensory acuity, the ability to receive information [3—5]. SP is differentiated from Sensory Integration Theory, the study of unconscious neural processes used to organize, categorize, and utilize environmental stimuli in the production of effective behavior [5,6]. It is also important to differentiate between SP and SP dysfunction (SPD), a term that implies significant impairment in social—emotional development or motor skills often associated with the autism spectrum [3,4].

Incontinent children appear to be different from children without incontinence. Common symptoms noted in the literature include urinary urgency, abnormal posturing, nocturnal enuresis and fecal incontinence [2,7]. They appear to exhibit behavioral or psychological problems such as anxiety, attention deficit/hyperactivity, oppositional behavioral, or conduct disorders at higher rates than continent cohorts [8]. Even those with monosymptomatic nocturnal enuresis often display higher rates of behavioral problems such as conduct disorders [7,8]. Yet it is unclear if incontinence is a result of behavioral problems, or the reverse [7,9,10]. If problematic behaviors and emotions result from problematic differences in SP, as has been suggested in the literature, then significant differences in SP should be found among school children with typical development and UI who appear to lack significant neuropsychiatric problems [4,6].

Studies have shown that children with greatly impaired SP, such as those with SPD, also appear to have immature neural processing, especially with regard to impaired registration of sensory stimuli [4,8,11]. It would seem plausible that there might also be similar, less pronounced differences in the development of the CNS among typical school-aged enuretics [8,11]. Differences in sensory registration (the ability to notice sensory stimulation) may be of particular significance for enuretic children who appear unable to act upon bladder signals [4,10,12]. Some children may appear to be unresponsive to wet clothing, but this may be a characteristic sensory response for the child in that particular situation.

Enuretic children appear to be at greater risk for behavioral or emotional problems [13]. A SP model may provide a link between emotion and behavior by describing characteristic SP. It is likely that there are specific areas within the brain that control SP and there is a growing body of research to support this in both children and adults [8,11,14,15].For example, in adult enuretics, measurement of the right hemisphere demonstrates cortical thinning, with lower scores for attention and visual memory [11,16]. Brain activity in regions concerned with emotions or decision-making also appears altered in adults with urinary urgency [17]. Studies of depressed adults show functional differences in magnetic resonance imaging signal processing within the prefrontal cortex, and parietal and lateral temporal lobes of the brain [8,11]. These physical differences may affect concentration, ideation, and coordination, and, in turn, might also affect SP [12,15]. There might be similar physical findings in children with UI.

Measurement of the prepulse inhibition of the startle reflex (a measure of sensorimotor gating) has been shown to decrease in enuretic children [18,19]. School-aged children with urinary frequency and UI, without comorbid conditions such as urinary tract infections or vesicoureteral reflux, have been found to possess distinct behavioral characteristics, which may be related to differences in SP [4,13,20]. A longitudinal study of 8000 school-aged children demonstrated a relationship between urinary frequency, hyperactivity, and conduct issues [7,13,21]. In a sample of 925 children who were followed from infancy until school age, 16% of children reported being bothered by tactile or auditory sensation [12]. Sensory hypersensitivy has also been proposed as a factor in the relationship between sleep and behavioral disorders in normal children [22]. It is therefore likely that measureable differences in SP may be found in normal children with UI. It is proposed that typically developing children with UI will exhibit significant differences in global SP, and that there will be differences in sensory subtypes that will correspond to specific urinary symptoms.

Materials and methods

A convenience sample of 209 school children aged 5—11 years were enrolled from children presenting at a pediatric bladder control clinic with a complaint of UI. All were referred by the primary care physician with symptoms of UI. A complete history and physical examination was performed, and urinary symptoms were classified using International Children's Continence Society (ICCS) nomenclature [23]. All eligible children were invited to participate and children were continuously enrolled until the sample size was reached, based on power analysis using a medium population effect ($d = 0.5$) [24]. UI was defined as incontinence in a child with voluntary bladder control. Children with nocturnal enuresis were included owing to findings in the literature that suggest increased risk for behavioral problems and therefore an increased risk of differences in SP [8,11]. Therefore, UI was further subdivided as follows: monosymptomatic nocturnal enuresis, daytime incontinence without NE (Nocturnal Enuresis), combined day- and nighttime incontinence, and UI with constipation based on