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Mary R. Pollock
The University of Toledo

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The Association Between Sensory Processing Disorder and 
Dysfunctional Elimination Syndrome in Children

Mary R. Pollock
Research Advisor: Alexia E. Metz, Ph.D., OTR/L
Occupational Therapy Doctorate Program
Department of Rehabilitation Sciences
The University of Toledo
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Abstract

This research examined whether sensory processing disorder (SPD) exists at a higher rate in children who exhibit dysfunctional elimination syndrome (DES). The primary hypothesis was that children ages 5-10 who have DES have a higher rate of SPD than the general population. The secondary hypothesis was that there is a correlation between DES and SPD. Study participants were children aged 5-10 who sought treatment for DES (n=19). Control participants were healthy children aged 5-10 who attended a well visit (n=55). Measures included the Short Sensory Profile (Dunn, 1999) and the Vancouver NLUTD/DES Questionnaire (Afshar, Mirbagheri, Scott, & MacNeily, 2009). In the study group, 52.6% of participants had definite differences in sensory processing, which was significantly higher than those found by Ahn et al. (2004), p<0.001. In the control group, 7.3% of participants had definite differences in sensory processing as indicated by the SSP which did not differ from the findings of Ahn et al. (2004), p = .333. There was a significant association between the occurrence of DES and SPD ($\chi^2 (1) = 20.869, p<0.001$) and a significant correlation between test scores (Spearman’s $\rho =-.493, R_s^2=.243, p<0.001$). The findings provide a novel factor to consider in the diagnosis and treatment of DES. According to the results of the present study, many children with DES also have SPD. This suggests that a child’s sensory processing pattern may be an important aspect of his/her medical history that could influence the child’s plan of care for treating the DES. The findings also motivate future research into shared underlying causes of DES and SPD.
The Association Between Sensory Processing Disorder and Dysfunctional Elimination Syndrome in Children

Introduction

For most children, toilet training follows a predictable developmental path. However, some children, despite having no apparent physical, physiological, psychological, or developmental concern, have trouble with bladder and bowel continence. Independent toileting is an important aspect of self-care. Elimination disorders have significant impact on the individual child and his/her family. The ability to toilet independently determines access to scholastic, social, and community opportunities. Children can begin pre-school starting at the age of three. In order to attend most pre-schools, children are required to be toilet trained. Meltz (2004) cites Barbara Willer, deputy executive director of the National Association for the Education of Young Children (an organization that accredits preschools), as saying “preschools historically have wanted children to be trained because diapering is time-consuming and they lack the facilities for it” (Meltz, 2004, para. 4). Each state sets forth requirements regarding diaper changing procedures and required changing facilities in licensed preschools. In Ohio, diapering requirements can be found in the Ohio Revised Code for preschool program licensing as set forth by the Ohio Department of Education in cooperation with Ohio Department of Job and Family Services under Section 3301-37-12 Diapering. Many preschools are unable to or choose not to provide diaper-changing services due to the necessary logistical and space requirements set forth by the state licensing. In addition to a lack of facilities, having children who require diapering in a classroom can impact the state mandated teacher-child ratio that must be maintained at all times while the children are in the care of the preschool. When a teacher is changing the diaper of one child, he/she cannot be counted as part of the teacher ratio for the
remaining children. For logistical and staffing reasons, it is easier for the schools to require that all children be toilet-trained to attend the preschool.

This research examines whether sensory processing disorder exists at a higher rate in children ages 5-10 who exhibit dysfunctional elimination syndrome (DES). We begin with a review of the literature examining developmental aspects of toileting, dysfunctional elimination, sensory processing disorder, and the roles of the autonomic nervous system in elimination and sensory processing disorder.

**Developmental Aspects of Toileting**

Children typically toilet train by the age of three in the United States (Schonwald, Sherritt, Stadtler, & Nridgemohan, 2004). Several studies have provided evidence that success in toilet training is linked with development. Blum, Taubman, and Nemeth (2003) demonstrated that earlier initiation of training results in earlier completion of training; however, it also requires longer duration for completion. The researchers included 406 children between the ages of 17 and 19 months at the start of the study who were followed until their daytime toilet training was completed. Initiation of training before 27 months was correlated with longer duration of training. Yet, they also showed that earlier initiation of training was not found to be associated with future bowel dysfunction such as constipation, stool withholding, or stool toileting refusal. Joinson and colleagues (2009) reported that in a group of 4.5 to 9 year-old children, initiation of training after 24 months was associated with an increase in the incidence of daytime wetting at school age. Barone, Jasutkar, and Schneider (2009) found that initiation of toilet training after 32 months was associated with urge incontinence. In summary, the literature suggests that while early initiation of toilet training is not associated with any future dysfunction, it also does not speed obtainment of toileting. On the other hand, the literature does suggest that delayed
initiation of toileting can be associated with later dysfunction. Also, it should be noted that contrary to the literature cited above, clinicians at the urology clinic in which this study was conducted, have observed that many clients who seek treatment for dysfunctional elimination syndrome often do report early initiation of toilet training. Shaikh and colleagues (2003) noted no relationship between the age of initiation of toilet training and dysfunctional elimination syndrome.

Schum and colleagues (2002) examined sequential acquisition of toilet training skills by age and gender in normal children. Their findings showed that girls achieve toilet-training skills at an earlier age as compared to boys. The median age for staying dry during the day was 32.5 months for girls and 35 months for boys. Girls showed an interest in toileting at a median age of 24 months as compared to boys at 26 months. Likewise, girls were able to stay dry for two hours at a median age of 26 months as compared to 29 months for boys. In addition, girls expressed the need to toilet at a mean age of 26 months as compared to the 29 months for the boys. These findings suggest that there is a similar pattern for achieving this individual skill in both girls and boys. The researchers also concluded that what is considered a normal range for an individual to demonstrate readiness and master toileting could vary by up to a year. In addition, they concluded that, “The ages when children achieve typical readiness skills, now in the range of 22-30 months, is older than previously reported” (Schum et al., 2002, p. 9).

Other supporting research examined the bowel habits and toilet training in a diverse population of typically developing children between the ages of 5-8. Wald and colleagues (2009) found that the mean age for initiating toilet training was 27.2 months, while the mean age of completion was 32.5 months. Similar to Shum et al. (2002), they found that girls trained almost three months earlier than boys. In addition, the researchers also noted that African–
American children began and completed toilet training at least six months earlier than Caucasian children. Regarding bowel habits, the findings showed similar bowel habits for all the children between the ages of 5 – 8 regardless of the age of completing toilet training. The researchers also reported that this population of 1142 children, ages 5-8 years old, had a medium-sized bowel movement either daily or every other day. In addition, while 10% of the children met the clinical criteria for clinical constipation, most of the children were able to void their bowels without straining or withholding.

Largo and colleagues (1999) examined development of bladder and bowel control in healthy children who had been born preterm as compared to children born at term. In this study, 104 preterm children and 349 healthy children were assessed through structured parental interviews and neurodevelopmental assessments at regular intervals between 1 and 24 months. Then, children were assessed at yearly intervals until the age of six. The findings showed that development of bladder and bowel was not affected by “prematurity, adverse perinatal events, or mild to moderate neurological impairment, nor is it related to psychomotor development or …socioeconomic conditions” (Largo et al., 1999, p. 115). The research of Largo et al. (1999) supports the premise that control of bladder and bowels is a maturational process that is not altered by early onset or high intensity training. It should be noted, contrary to the findings above, the clinical observations where this present study was conducted, do suggest that some children with medical complications of prematurity do experience problems with elimination later in life.

**Dysfunctional Elimination Syndrome**

DE denotes abnormal voiding habits and patterns in children such as stool holding, constipation, or incontinence (Koff, Wagner, & Jayanthi, 1998). Voiding dysfunction and
constipation were so frequently described clinically and in literature that the term DES was coined to describe to this subset of children (Neveus et al., 2006; Norgaard, van Gool, Hjalmas, Djurhuus, & Hellstrom, 1998). Symptoms of DES vary from urinary frequency, incontinence, holding maneuvers (such as squatting and crossing of the legs), urgency, constipation, and encopresis. There is no known etiology for DES, however, it represents a deviation in the normal developmental phase of urinary and bowel control with no anatomic or neurological disease present. The onset of DES can occur for some children after they are fully toilet trained while for other children the onset occurs while the child is toilet training.

With DES, some children have trouble with enuresis while others may have encopresis. According to the American Psychiatric Association’s *Diagnostic and Statistical Manual of Mental Disorders, 4th edition* (DSM-IV), to be diagnosed with enuresis, the child must be at least five years old and either “accidentally or on purpose repeatedly urinates into clothing or the bed” (Morrison, 2006, p. 528). In addition, this behavior occurs at least twice a week for a minimum of three consecutive months. Or, the behavior causes “distress or impairs work (scholastic), social, or personal functioning” (Morrison, 2006, p. 528). Enuresis can be nocturnal only, diurnal only, or both. Encopresis is diagnosed when a child is at least four years old, and accidentally or on purpose, “repeatedly passes feces into inappropriate places (clothing, the floor)” at least once a month for a minimum of three months (Morrison, 2006 p. 528). Encopresis can occur with or without constipation and overflow incontinence.

Voiding dysfunction refers to the inability to properly empty the bladder and is caused by the inability to relax the urethra and pelvic floor muscles with voiding, resulting in urinary retention or incomplete bladder emptying. According to Tokgoz et al. (2007), “Approximately, 40% of children admitted to pediatric urology clinics are assumed to have voiding dysfunction”
Voiding dysfunction can result from urethral sphincter over-
activity (Halachmi & Farhat, 2008). Urinary incontinence, which can be defined as stress or
urge urinary incontinence, is the inability of the bladder to properly store urine resulting in
involuntary leakage of urine.

Constipation, or retained stool in the rectosigmoid colon, can cause urinary dysfunction. Constipation can be the core of the urinary dysfunction by compressing the bladder and reducing its functional capacity. Klijn and colleagues (2004) advocate for the treatment of constipation as a way to help resolve issues with dysfunctional voiding of urine as a result of their findings in which children with DES had a larger diameter rectum (4.9 centimeters as compared to a control group at 2.1 centimeters). This causes compression on the bladder and results in frequency incontinence because the sensation to void occurs before the bladder is full (Halachmi & Farhat, 2008). According to Prynn (2011) constipation affects 5-30% or children at equal rates in boys and girls and rates are not influenced by socioeconomic status. Halachmi and Farhat (2008) report that encopresis is more common in males than females by three to six times. Halachmi and Farhat (2008) suggest that positioning may contribute to the higher incidence of stool leakage into boys’ underwear as compared to girls. When toileting, girls sit on the toilet and remove their underwear allowing for the passage of stool when urinating. However, boys typically stand with voiding urine and any passing of gas while toileting can result in leakage into the boys’ underwear secondary to toileting positioning. Shaikh et al. (2003) found, “Approximately 50% of the children with DES had encopresis, underscoring the importance of addressing constipation in these children” (Shaikh et al., 2003, p. 1137). Constipation and DES should not be viewed as mutually exclusive. Bijos, Czerwionka-Szaflarska, Mazur, and Romanczuk (2007) used ultrasonography and found that in addition to having a larger diameter rectum, children with
fecal impaction also had significantly longer transit time in the colon and the rectum. Bijos, et al (2009) suggest using ultrasound to distinguish megarectum from DES.

**Etiology of dysfunctional elimination syndrome.** There is no clear understanding of why some children without physical, physiological, or developmental issues have trouble with bowel and bladder training. There has been little research to determine the differences between children who typically toilet train and those who do not. Research has examined age of initiation for toilet training, behavioral characteristics of the child, temperament of the child, temperament of the parent, parent perceived stubbornness, and parenting styles in hope of finding significant contributing factors to difficult toilet training.

Schonwald and colleagues (2004) found that children with training difficulty were more likely to be constipated and more likely to have difficult temperamental traits. They described children who had difficulty toilet training as “less adaptable, more negative in mood, less persistent, and lower in approach…and more likely to be constipated” (Schonwald, et al. 2004, p. 1753). Burket and colleagues (2006) found that children with constipation were perceived by their parents to be more stubborn than the control group especially in terms of toileting. This research also found that when the constipation resolved the parents’ perceived stubbornness of their children also decreased. Shaikh et al. (2003) found two variables that were associated with DES, encopresis and a high child vulnerability score, which measures the parent perception of the child’s vulnerability. According to Shaikh et al. “It seems possible that parents who consider their child vulnerable may be more likely to report symptoms of DES. Conversely, as with other chronic conditions, DES may lead parents to consider their child more vulnerable” (Shaikh et al., 2003, p. 1137). Finally, through survey research, Joinson, Heron, and von Gontard (2006) found
that children who were reported as having attention problems, oppositional behavior, and conduct problems were twice as likely to also have day-time wetting problems.

Blum, Taubman, and Osborne (1997) found that children who refuse stool toileting do not have more behavioral problems as compared to the control group; however, they do have a higher reported rate of constipation and painful defecation. Wald et al. (2009) found that 10% of their population met the criteria for constipation. Taubman Nemeth, and Blum (2004) identified three factors that contribute to later toilet training including a later age of initiation, stool refusal, and constipation. Straining and infrequent voiding were more common in girls, and large bowel movements and overflow were more common in boys.

Other research has examined whether dysfunctional elimination syndrome maybe partially learned in the school setting. Cooper, Abousally, Austin, Boyt, and Hawtrey (2003) suggest that DES could result from the fact that most of a child’s day is spent at school. They reported that 80% of elementary school teachers, who participated in the survey-based research, reported having set-times for bathroom breaks. Fifty percent reported requiring all children to go to the bathroom at that set-time. One-third of teachers denied bathroom requests that occurred during the class by asking the child to wait. In addition, the teachers who were surveyed noted poor sanitation in the bathrooms especially post-kindergarten and as the school day progressed. Finally, 42% of the teachers noticed bullying and 34% noticed a lack of supervision in the boy’s bathrooms.

Lundbald and Hellstrom (2005) suggest that urinary and bowel problems can result from irregular toileting. This research surveyed children ages 6 – 16 and found that the children had a negative perception of the school toilets. Children reported avoiding school toilets due to sense impressions including visual perceptions of dirty toilets and bathroom odor. Other contributing
factors included privacy, anxiety, embarrassment, and fear. Children were more willing to endure the physical discomfort of not using the bathroom over the psychological and social anxiety of using the school toilets. As a result, the school children undergoing treatment for dysfunctional elimination syndrome often ignored the recommendation to regularly void during school hours. Lundbald and Hellstrom (2005) conclude that children’s negative perceptions of school toilets may be an underestimated factor that contributes to dysfunctional elimination syndrome. Likewise, this negative perception can also act as a barrier to effective treatment management of urinary and bowel problems.

While research has examined many factors that potentially contribute to dysfunctional elimination syndrome, an area not yet examined is the association of sensory processing disorder and its relationship to dysfunctional elimination syndrome.

**Sensory Processing and Sensory Processing Disorder**

Research has reported that 40-88% of children with various disabilities such as attention deficit hyperactivity disorder (ADHD), fragile X syndrome, and autism also have sensory processing disorder (Ahn, Miller, Milberger, & McIntosh, 2004). McIntosh, Miller, Shyu, and Hagerman (1999) report SPD symptoms are seen in up to 10-12% of the general population and up to 30% of those with developmental disabilities. Ahn, et al. (2004) examined typically developing kindergartners to determine the level of sensory processing disorder in the general population. The results of Ahn et al. (2004) showed a conservative estimate of 5.3% of the general population having sensory processing disorder.

Jean Ayres first used the term *sensory integration dysfunction* in 1963 (as cited in Miller, Anzalone, Lane, Cermak, & Osten, 2007). “Ayres (1972) defined *sensory integration* as ‘the interaction and coordination of two or more functions or processes in a manner which enhances
the adaptiveness of the brain’s response’ (pp. 25-26). She further defined the integrative process as filtering, organizing, and integrating sensory information” (Davies & Gavin, 2007, p. 177). “Sensory integration theory refers to constructs that discuss how the brain processes sensation and the resulting motor, behavior, emotion, and attention responses” (Miller et al., 2007, p. 135). Sensory integration dysfunction refers to the functional problems that result from impaired sensory processing. Sensory processing disorder (SPD) can affect “development and functional abilities in behavioral, emotional, motoric, and cognitive domains” (Ahn et al., 2004, p. 287). Sensory processing disorder is diagnosed when occupations of daily living are impaired because responses are not adaptive or consistent with the demands of the environment.

One conceptualization of SPD is Dunn’s Model of Sensory Processing. The first important construct in this model is that of threshold or the level of sensory input necessary for eliciting a response (Dunn & Brown, 1997). At one end of the continuum is a low threshold, where a person will notice and respond to very small amounts of input. At the other end is a high threshold, where a person will require larger amounts of input before responding. The second important construct is that of self-regulation (Dunn & Brown, 1997). Also, on a continuum, one may respond to sensory input with passive behaviors or active behaviors. Dunn’s Model of Sensory Processing suggests that neurological thresholds and self-regulation responses in relationship to sensory processing results in four patterns including: sensation seeking, sensation avoiding, sensory sensitivity, and low registration (Dunn, 2007). Response to sensation can occur at a low level of input or due to a low threshold or can occur as the result of excessive sensory input or due to a high threshold. Likewise self-regulation, as seen by the behavioral response to sensory input, can be either active or passive. Sensation seeking patterns are seen in those children who have a high threshold for sensation and actively seek out sensation
as a means of self-regulation. Sensation avoiding patterns are seen in those children who have a low threshold for sensation and actively avoid sensation as a means of self-regulation. Sensory sensitivity is seen in children with a low threshold for sensation and passive behavior strategies in response to sensation. Finally, the last category is low registration that is defined by a high threshold for sensation and passive behavior strategies for self-regulation (Dunn, 2007).

In a slightly different classification model, Miller et al. 2007 proposes three different sub-types of sensory processing disorder including: Sensory Modulation Disorder (SMD), Sensory-Based Motor Disorder, and Sensory Discrimination Disorder. Sensory modulation disorder is further defined by three different sub-types based on threshold for and response to sensory input. Threshold for sensory input can be classified as either Sensory Overresponsivity, where a person will respond to a sensation faster and with more intensity or Sensory Underresponsivity where a person will fail to respond to sensory stimulation as compared to someone without SMD. The third sub-type for SMD is Sensory Seeking/Craving which includes people who seek a greater than normal amount of sensory input. Self-regulation, a person’s behavior in response to stimuli, may be passive or active in their attempt to control the sensory stimuli. Miller et al. (2007) note that with children who have SMD, “The atypical responses observed are not willful; they are automatic, unconscious physiologic reactions to sensation” (Miller et al., 2007, p. 137).

While SPD has been diagnosed clinically through measures of functional behavior using the Sensory Profile (Dunn, 1999), there has been little evidence-based research that confirms if in-fact children diagnosed with SPD actually have different physiological responses to stimuli.

**Autonomic Nervous System**

**Autonomic nervous system implicated in SPD.** Some research has demonstrated that individuals with SPD have abnormal sympathetic and parasympathetic reactions in response to
sensory stimuli (Ahn et al., 2004). Schaaf, Miller, Seawell, and O’Keefe’s (2003) study examines parasympathetic disturbance in relation to SMD. The population included a total of 15 participants with 9 having a SPD diagnosis. This research measured heart period data that was recorded using cardiac vagal tone index -- a non-invasive marker of parasympathetic activity. “It measures the variability of heart period within the frequency range of respiration. Heart period is the time interval from one peak r wave of the electrocardiogram to the next ” (Schaaf et al., 2003, p. 445). Measures were taken during the Sensory Challenge Protocol, which is a test that measures responses to repeated sensory stimulation in 5 areas with 10 continuous trials. Areas include olfactory, auditory, visual, tactile, and vestibular. The participants with disturbances in sensory modulation had statistically significant lower cardiac vagal tone, which serves as evidence of less effective parasympathetic functioning.

McIntosh, Miller, Shyu, and Hagerman (1999) showed that children who were diagnosed with SPD, demonstrated significantly greater electrodermal reactions (EDR) and were also were slower to habituate to the sensory stimuli. McIntosh, et al. (1999) looked at electrodermal response (EDR) to each stimulus of the Sensory Challenge Protocol. EDR was assessed by measuring changes in skin conductance associated with each stimuli. There were four non-responders in the SMD group validating high threshold associated with some SPD. There were no non-responders in the control group. McIntosh also administered the Short Sensory Profile to the same population. “When groups were divided into normal versus abnormal (eg. Hyporeactive or hyperreactive) electrodermal reactivity, the hypo- and hyperresponsive groups demonstrated significantly more impairment on the Short Sensory Profile, a functional scale of sensory behaviors” (Ahn et al., 2004, p. 288). The SMD group showed a hyperresponsive pattern of response to stimuli. While both groups showed a decrease in response with repeated exposure,
the SMD group habituated more slowly. All four children that were non-responsive had SMD. “Approximately 30% of the children with midrange EDR patterns and 80-87% of the children in the high groups had SMD” (McIntosh et al., 1999, p. 612). Therefore, it is hypothesized that the Short Sensory Profile (Dunn, 1999) can be used as an indicator of imbalance within the autonomic nervous system.

The research of Davies and Gavin (2007) examines the relationship between brain function and behavioral manifestations of SPD and validated the diagnosis of SPD as measured by electroencephalography. They examined sensory gating or “the brain’s ability to filter sensory information” and sensory registration or “the brain’s ability to organize sensory information” (Davies & Gavin, 2007, p. 179). The research used an EEG to measure brain activity in 53 children of which 28 were diagnosed with SPD. The research used the sensory gating paradigm, which addresses the function of the brain’s ability to filter sensory information. Administered were two clicks, with the first used as a conditioning click that makes the brain expect the second click. The second click is the test click because it tests whether the brain was prepared for (and therefore able to gate out) the second incoming stimuli. Both groups showed gating of the second click. However, the results showed that children with SPD were less able to filter out “repeated or irrelevant sensory input and fail to selectively regulate the sensitivity of cortical responses to additional incoming sensory stimuli” (Davies & Gavin, 2007, p. 186). In addition, the research showed that, “brain processing of simple auditory stimuli may be less organized in the children with SPD” (Davies & Gavin, 2007, p. 186). In this research, “the children with SPD were also shown to be either hyperresponsive or hyporesponsive in their sensory gating relative to the gating of children who were typically developing” (Davies & Gavin, 2007, p. 187.) While not statistically significant after controlling for multiplicity, children
with SPD, as a group, showed less gating than typical developing children. For typically developing children, their ability to gate out stimuli improves with age. For children with SMD their ability to demonstrate improved sensory gating with increased age did not occur. In addition, “Brain activity correctly distinguished children with SPD from children who were typically developing with 86% accuracy” (Davies & Gavin, 2007, p.176.) This research further supports the clinical diagnosis of SPD.

Bar-Shalita, Vatine, Seltzer, and Parush (2009) examined sensory detection thresholds. The research showed that children with SPD as compared to the control children, “showed significant cool hypoesthesia, higher pain intensity to pinprick and to prickly stimuli, and significantly more pain after sensation to the prickly stimuli” (Bar-Shalita et al., 2009, p. 631). The researchers hypothesize that these children have a more sensitive and active nocioceptive system.

The research of Parush, Sohmer, Steinberg, and Kaitz (2007) identifies discriminative markers of tactile defensiveness (TD) and link them to neurological dysfunction. The goal of this research was to “find empirical support relating TD to electrophysiological and psychophysical measures in order to test for objective measures that discriminate between children with and without TD” (Parush et al., 2007, p. 554). The population included children diagnosed with both attention deficit hyperactivity disorder (ADHD) and TD and those with ADHD without TD. The control group included children without an ADHD or TD diagnosis. The results showed that ADHD with TD was distinguishable from ADHD without TD on the somatosensory evoked potential (SEP) amplitude by larger central SEP amplitude. This research establishes a link between SMD and atypical CNS processing. “The present data supports the claims that TD is a discernable entity, marked by anomalous physiological responses to
somatosensory stimuli. Furthermore, the data are consistent with the contention offered previously, that TD, and perhaps SMD in general, is related to disruptions in neural inhibition” (Parush et al., 2007, p. 557).

Taken together these studies validate that children with SPD have distinct physiological, neural, electrodermal, and vagal tone differences as compared to typically developing children. The EEG and the EDR were able to distinguish the diagnosis of SMD and validate the use of the Sensory Profile (Dunn, 1999) as a diagnostic tool. The EEG sensory gating paradigm, which addresses the function of the brain’s ability to filter sensory information, could identify correctly children with SPD as compared to typical children with 86% accuracy. According to Davies and Gavin (2007), “These neurophysiological findings provide evidence to support the validity of the diagnostic category of SPD, which before this study had been defined primarily through behavioral measures” (Davies & Gavin, 2007, p. 188).

**Autonomic nervous system function in bladder and bowel control.** Bladder and bowel control and activation are dependent on the balance of and interaction between the branches of the autonomic nervous system. The sympathetic nervous system is primarily responsible for maintaining optimal blood supply to the organs by either decreasing sympathetic activity through vasodilatation or increasing sympathetic activity through vasoconstriction of the blood vessels (Lundy-Eckman, 2007). The sympathetic nervous system also regulates body temperature, blood flow to skeletal muscle, dilation of the pupils, secretion by the salivary glands, increased heart rate, and bronchial dilation. “In the gastrointestinal tract, sympathetic signals contract sphincters and decrease blood flow, peristalsis, and secretions. Sympathetic stimulation also inhibits contraction of the bladder and bowel walls and contracts internal sphincters (Lundy-Eckman, 2007, p. 178). The primary responsibility of the parasympathetic
nervous system is energy conservation. It facilitates digestion and regulates bowel and bladder voiding. For the bladder and bowels the effects of the sympathetic and parasympathetic system are synergistic. “Their opposing actions are balanced to provide optimal organ function (Lundy-Eckman, 2007, p. 179). A decrease in the sympathetic activity with an increase in parasympathetic activity facilitates voiding of the bladder and bowels.

The Present Study

Given that the function of bowel and bladder voiding is dependent on a synergistic balance between the sympathetic and parasympathetic nervous system and that SPD may result from an imbalance in the autonomic nervous system, is it possible that DES and SPD co-exist and are related to one another? The current study examines these questions. The primary hypothesis was that children ages 5-10 who have a diagnosis of DES will have a higher rate of SPD than the general population through comparison with the normative population of the standardized screening instrument to be utilized, The Short Sensory Profile (Dunn, 1999), and as found by Ahn et al. (2004), to be 5.3% of the general population. To control for regional differences in sensory processing or the local culture of reporting on behaviors indicative of sensory processing, we tested whether a healthy pediatric population had a higher rate of sensory processing disorder than that reported by Ahn et al. (2004).

The secondary hypotheses was that there is a correlation between DES and SPD as measured by the Vancouver Nonneurogenic Lower Urinary Tract Dysfunction/Dysfunctional Elimination Syndrome Questionnaire ([Vancouver NLUTD/DES], Afshar, Mirbagheri, Scott, & MacNeily, 2009) and the Short Sensory Profile ([SSP], Dunn, 1999).

Method

Design
ASSOCIATION OF DES AND SPD IN CHILDREN

This study employed cross-sectional survey using standardized instruments in a targeted clinical population and a convenience, control population.

Participants

**Study group.** Parents or legal guardians over the age of 18 who had children aged 5-10 and who sought treatment for dysfunctional elimination not explained by a medical diagnosis or physiological problem were recruited from a mid-western pediatric urology office to participate in this study. Major medical diagnosis, cognitive impairment, and mental health diagnosis, as judged by the urology clinic staff, were criteria for exclusion from this study.

**Control group.** Parents or legal guardians over the age of 18 with children aged 5-10 who took their child to their regular pediatrician for a well visit were recruited from two mid-western family practice offices to complete surveys as part of a control group. Major medical diagnosis, cognitive impairment, mental health diagnosis, and a known diagnosis of dysfunctional elimination syndrome, as judged by the participating doctors’ or nurse practitioners’ review of the child’s medical history provided, were criteria for exclusion from this study.

Materials

In both the study group and the control group, caregivers completed the Vancouver Nonneurogenic Lower Urinary Tract Dysfunction/Dysfunctional Elimination Syndrome Questionnaire ([Vancouver NLUTD/DES], Afshar, Mirbagheri, Scott, & MacNeily, 2009) and the Short Sensory Profile ([SSP], Dunn, 1999). In addition, socioeconomic information was obtained using the Four Factor of Social Status by Hollingshead (1975). The purpose of using the Four Factor of Social Status survey information is to more accurately describe the group of people who participated in this study.
Vancouver NLUTD/DES. Farhat et al. (2000) published the first screening symptom score for dysfunctional voiding for the pediatric population. Since 2000, other tools have been developed with no one instrument considered to be the standard for diagnosing DES. For this present research proposal, we reviewed six different DES/dysfunctional voiding symptom-scoring instruments including: the Dysfunctional Voiding Symptom Score (Farhat et al., 2000; Calado et al., 2010); the Dysfunctional Voiding and Incontinence Scoring System (Akbal, Genc, Burgu, & Tekgul, 2005; Tuygun et al., 2007); the Questionnaire for DES (Tokgoz, 2007); the Pediatric Lower Urinary Tract Symptom Score (Dogen et al., 2008); the Vancouver NULTD/DES Questionnaire (Afshar, Mirbagheri, Scott, & MacNeily, 2009); and the International Consultation on Incontinence Questionnaire-Pediatric Lower Urinary Tract Symptoms (De Gennaro et al., 2010). Many tools do not have questions that adequately address bowel symptoms. As a result, the decision was made to use the instrument developed by Afshar, Mirbagheri, Scott, and MacNeily (2009) from the Department of Urological Sciences, University of British Columbia, Canada. They developed the Vancouver NLUTD/DES Questionnaire, which was published in 2009.

The Vancouver NLUTD/DES Questionnaire includes a total of 14 statements with a five point Likert scale response and can be completed in a few minutes. The questionnaire is completed by the parent for the child from the child’s perspective, although it can be answered by children themselves for ages nine and older. Each question addresses and asks about a single symptom. For each item, a score of zero means no complaints exist while a score of four reflects severe symptoms. Questionnaire statements relate to frequency of voiding, strain or pain upon voiding, and inability to control the bladder and bowels. Each question is weighted equally in
computing a total score. Afshar et al. (2009) used ROC analysis to determine a cut-off score of 11 for diagnosing DES.

To assess reliability of the Vancouver NLUTD/DES, it was administered to 50 participants and then re-administered again one week later (Afshar, Mirbagheri, Scott, and MacNeily, 2009). Test-retest reliability was 84.5% (p=0.001), Pearson’s correlation coefficient was 0.845 showing excellent reliability. Discriminate function analysis showed 80% accuracy for correctly classifying sample patients. The ROC curve showed score of 11 as optimum threshold with an AUC of 0.903 (95% confidence interval 0.814-0.948). A total score of 11 associated with 80% sensitivity and 91% specificity. Median scores for two groups was statistically significant p=0.001. Cornbach’s alpha was modest at 0.445 showing that NLUTD/DES is a heterogeneous clinical syndrome, as described. Finally, 85% of participants classified the questionnaire as very easy or easy to complete.

SSP. The SSP (Dunn, 1999) is a tool used to identify children with sensory processing difficulties. The SSP includes 38 statements, which the parent responds to with a Likert-like scale of ratings that include: always, frequently, occasionally, seldom, and never. The statements and responses assess seven areas of sensory processing including: tactile sensitivity, taste/smell sensitivity, movement sensitivity, underresponsive/seeks sensation, auditory filtering, low energy/weak, and visual sensitivity. The SSP takes about 10 minutes to complete and all questions must be answered to obtain a score. A score is calculated for each area and then totaled. For the SSP, scores are compared to a normative population of 1037 children without disabilities between the ages of 3 and 10. Scores are classified as “Typical Performance” (within one standard deviation of the mean) “Probable Difference,” (within two standard deviations) and
“Definite Difference” (beyond two standard deviations) as compared to the mean of the normative population (McIntosh, Miller, Shyu and Dunn, 1999).

The SSP is a shortened version of the 125-question Sensory Profile. Psychometric studies of the SSP demonstrated internal reliability of the test total and sections (Cronbach’s Alpha of .70 to .90). “Content validity (through expert consensus), construct and convergent validity (with correlations as expected with the School Function Assessment by Coster, Deeney, Haltiwanger and Haley (1998)” are established (McIntosh et al., 1999, p. 59-74). As mentioned, “Approximately 30% of the children with midrange EDR patterns and 80-87% of the children in the high groups had SMD” (McIntosh et al., 1999, p. 612). Therefore, it is hypothesized that the Short Sensory Profile can be used as an indicator of imbalance within the autonomic nervous system. In addition, the EEG sensory gating paradigm, which addresses the function of the brain’s ability to filter sensory information, could correctly identify children with SPD as compared to typical children with 86% accuracy. “Brain activity correctly distinguished children with SPD from children who were typically developing with 86% accuracy” (Davies & Gavin, 2007, p.176). This research further supports the clinical diagnosis of SPD. The EEG and the ERD were able to distinguish the diagnosis of SMD and validate the use of the Sensory Profile as a diagnostic tool.

**Socioeconomic status.** The Hollingshead Four Factor Index of Social Status (Hollingshead, 1975) is a four-factor index that takes into account education, occupation, sex, and marital status to determine an estimation of social status of individuals and, in turn, households. A score is calculated by assessing highest level of education attained, occupation, and whether the family is a single parent home or a two-parent home. The score determines a
generalization that can be made about social status. Scores range from a low of eight to a high of 66. The higher the score, the more status attributed to that person or household.

**Procedure**

**Study group.** The parent was introduced to the research study, at the end of the patient’s regularly scheduled visit, by clinical research personnel and asked for consent to participate. If the parent/guardian agreed to participate in the study, they were given the Vancouver NLUTD/DES, the SSP, and the Four Factor Index of Social Status to complete. The participant remained in the patient room to complete the surveys in privacy. Completed surveys were returned to one of the investigators before leaving the pediatric urology office.

**Control group.** The nurse practitioner asked the parents, after completing a well visit, if they would like to participate in survey research. The nurse practitioner did not administer consent or answer questions about the research. If the parent agreed, they were given a closed stamped, addressed envelope containing the study materials. Caregivers took the materials with them from the pediatrician’s office. Contact information for the researchers was provided on the consent form so that questions could be answered. The caregivers completed the consent form, the Vancouver NLUTD/DES Questionnaire, the SSP, and the Four Factor Index of Social Status. The completed surveys and consent were returned in a stamped, addressed envelope to the lead researcher.

Families who agreed to participate and who took a research packet were asked, before leaving the pediatrician’s office, to provide contact information for follow-up by the researchers. The potential participant provided information on an individual form that was returned to the researchers from the pediatricians’ office in a closed envelope. After a minimum of two weeks, a researcher contacted the individuals who had not returned completed surveys to encourage
them to complete and return the surveys. Also, the researcher offered to answer any questions
the potential participant had about the research.

**Both groups.** For both the study group and the control group, completion of the three
instruments concluded the participants’ participation in this present study. Participants were also
eligible to complete an entrance form to win one of four $50.00 gift certificate to Toys R Us for
participating in this study (two gift cards were awarded for the control group and two for the
study group).

When a child’s scores indicated a total score of probable difference or definite difference
on the SSP, the parent/guardian were provided written educational materials about sensory
processing and a report of their child’s scores on the Short Sensory Profile. Furthermore, the
parent information suggested that the parent/guardian follow-up with their primary health
provider and seek out a referral to an occupational therapist due to the fact that sensory
processing disorder should be fully assessed and can create disruption in other areas of function
beyond elimination.

**Data Analysis**

**Scoring of survey instruments.** Participants were categorized as having SPD if their
Short Sensory Profile score fell into the Definite Difference range (beyond two standard
deviations) as compared to the mean of the normative population. When scoring the Short
Sensory Profile, if a score was missing for a single item, the score for that item was entered as a
5 (never) to guard against bias toward sensory processing. This occurred for two participants in
the study group and two participants in the control group. Scoring this way avoided
categorization in the Probable Difference category for one participant but did not change
categorization for the remaining three. On the Short Sensory Profile, participants with more than
one item score missing were excluded from analysis resulting in one control participant being
excluded.

Participants were categorized as having DES if the total Vancouver NLUTD/DES score
was equal to or greater than 11. When scoring the Vancouver NLUTD/DES Questionnaire, if
two answers were circled for a single item the averaged score of the two answers given was used.
Furthermore, if a score was missing for a single item, the lowest score (zero) was used to avoid a
bias toward DES. However, it happened that all participants with missing items scored above
the cut point for DES even with incomplete responses. Incomplete responses on the Vancouver
NLUTD/DES Questionnaire included one control participant who omitted one question, three
study participants who had one item that could not be scored and two study participants who had
two or more unscored items. Because the six participants (1 control and 5 study) met the criteria
for DES despite incomplete data, the participants’ data was included in the analysis.

Analysis. The collected data was assessed for normalcy. Distribution of the SSP scores
in the study population demonstrated kurtosis. In keeping, nonparametric analyses were used to
test the first hypothesis. The frequency of SPD within the study and control groups was
compared to the findings of Ahn et al. (2004) with a nonparametric binomial test. To test the
secondary hypothesis, data from both the study and the control group have been combined to
allow for a range of scores on both assessments. A Chi-Square \( (df=1) \) test was used to assess the
correlation of categorization in DES and SPD. Correlation between the Short Sensory Profile
and the Vancouver NLUTD/DES Questionnaire scores was assessed using Spearman’s
correlation coefficient \( R_s^2 \) value. Significance was determined using \( \alpha = 0.05 \).

Results
The staff at the urology clinic obtained informed consent from the parents/guardians of 21 clients judged to meet the criteria for DES; however, two did not meet the age criteria. One hundred and twenty-five research packets were distributed at two general pediatric practices. Fifty-seven were returned for a total return rate of 45.6% return rate. Two control participants were excluded from analysis. One participant did not meet the inclusion criteria for age and the other participant had incomplete data. In total, 19 study participants and 55 control participants were entered into analysis. The authors of the Vancouver NLUTD/DES Questionnaire found that the 85% of participants classified the questionnaire as very easy or easy to complete. In our study, 87% of the control participants and 74% of the study participants found the Vancouver NLUTD/DES Questionnaire very easy or easy to complete.

**Participant Demographics**

For the demographic characteristics of the participants refer to Table 1. The study group was significantly older than the control group by 1.4 years. The average Hollingshead Four Factor of Social Index score for the study group was in the middle class, and the average score of the control group was in the upper middle class. The difference was not statistically significant.

Amongst the control participants, the average age of daytime toilet training was 2.7±0.7 years (range 1 to 4.20 years). The average age of nighttime toilet training, of the participants who were trained (n=50), was 3.3±1.32 years (range 1.0 to 7.3). Of the 55 participants, four were not yet trained at night and one participant did not note the age of nighttime obtainment. As noted in the introduction, other research examined the bowel habits and toilet training in a diverse population of typically developing children between the ages of 5-8. Wald and colleagues (2009) found that the mean age for initiating toilet training was years 27.2 months while the mean age of completion was 32.5 months. Wald et al. (2009) and Shum et al. (2002)
found that girls trained almost three months earlier than boys. Therefore, the control sample is reflective of typical toilet training patterns.

**Higher Rate of SPD in Children With DES**

All study participants in fact had a score that indicated DES. Ten of the nineteen (52.6%) participants in the study group also had definite differences (beyond two standard deviations) in sensory processing, as indicated by the SSP. This proportion of participants in the study group with SPD was significantly higher than those found by Ahn et al. (2004), p<0. In the control group, four of 55 (7.3%) participants had definite differences in sensory processing as indicated by the SSP. The proportion of participants with SPD in the control group did not differ from the findings of Ahn et al. (2004), p = .333.

**Correlation of DES and SPD**

Data for the two populations were combined to assess the correlation of DES and SPD. Refer to Table 2 for the number and proportion of the sample meeting the criteria for DES and SPD. There was a significant association between the occurrence of DES and SPD ($\chi^2 (1) = 20.869, p<0.001$). Expected frequencies in all categories were greater than 5. At 0.531, Cramer’s $V$, indicates a strong association, $p<0.001$. The standard residual for SPD without DES was -2.6 and for SPD with DES was 3.2 while the others were $\pm 1.96$, indicating that the low number of participants with SPD who did not have DES and the high co-existence of SPD and DES account for the significant finding. The odds ratio of having SPD amongst those with DES was 13/16 (0.813); the odds ratio of not having DES amongst children with SPD was 1/13, or 0.08; and the odds of having SPD amongst the participants without DES was 1/44 (0.02).

There was a significant negative correlation (Spearman’s $\rho = -0.493$, $p<0.001$, see Figure 1) between SSP and DES scores such that participants with high DES scores tended to have
lower SSP scores (indicative of SPD). \( R_s^2 \) was .243, reflecting the proportion of ranks shared by the two variables. This approaches the medium effect size of 0.3 as suggested by Cohen (1992).

**Discussion**

The results support the primary hypothesis of this study that children ages 5-10 who have dysfunctional elimination syndrome have a higher rate of sensory processing disorder than the general population, as described by Ahn et al. (2004) at 5.3%. We tested whether a healthy pediatric population had a higher rate of sensory processing disorder than that reported by Ahn et al. (2004) to control for regional differences in sensory processing or the local culture of reporting on behaviors indicative of sensory processing,. The control sample showed a similar rate of SPD as found by Ahn et al. (2004). This validates the high rate of SPD found in the study sample.

The findings provide a novel factor to consider in the diagnosis and treatment of DES. According to the results of the present study, many children with DES also have SPD. This suggests that a child’s sensory processing pattern may be an important aspect of his/her medical history that could influence the child’s plan of care for treating the DES. For example, the health care practitioner and the child’s parents could take into account the child’s sensory needs as part of their plan for managing the child’s DES. If the child is over-responsive to sensory input, the parents could work with the child to find ways to minimize sensory input that could be negatively contributing to the child’s toileting behaviors. Minimizing sensory input could mean making changes to the toileting environment. Likewise, if the child is under-responsive to areas of sensory input, a traditional schedule of timed toileting may be helpful. Understanding a child’s sensory needs in combination with their DES could allow the parent to have a greater understanding of their child’s toileting behaviors. The behaviors associated with DES may be
physiological reactions that cannot be controlled by the child in response to the many sensations associated with toileting.

A greater understanding of DES is important for urologists, occupational therapists, pediatricians, and the general public. *Practicing Safety* is a project sponsored by the American Academy of Pediatrics and funded by the Doris Duke Charitable Foundation. The project “works to decrease child abuse and neglect by expanding anticipatory guidance and increasing screening for possible child abuse and neglect by pediatric practices to parents of children ages 0-3” (American Academy of Pediatrics, 2011). The project focuses on education and awareness in seven areas including: coping with crying, parenting, safety in other’s care, family environment, effective discipline, sleeping and eating, and toilet training. According to the American Academy of Pediatrics’ Practicing Safety project, “More abuse occurs during toilet training than during any other developmental step. Parents’ expectations often exceed the child’s abilities or understanding, and the child’s frustrations and imperfect attempts at self-control are easily mistaken for willful disobedience” (American Academy of Pediatrics, 2011). Toilet training and the ensuing accidents that are a normal aspect of children learning to become independent and competent with this occupation of daily living can become a concern for the child’s safety. Much of the child abuse prevention literature addresses positive ways of managing toilet training and serves to educate adults against using punitive measures when a child has toileting accidents.

The secondary hypothesis was that there is a correlation between DES and SPD as measured by the Vancouver NLUTD/DES and the SSP. Combining the data from both the study and the control group allowed for a range of scores on both assessments so that correlation could be tested. The results showed a moderate inverse relationship whereby those with low SSP
scores (indicating SPD) had high scores on the Vancouver NLUTD/DES Questionnaire (indicating DES). It could be suggested that SPD co-occurs with many diagnoses of childhood therefore these results are not selective to DES. The research of Van Hulle, Schmidt and Goldsmith (2012) examined if sensory over-responsivity, a sub-type of SPD, was distinguishable from other behavior problems in middle childhood. The authors found that 50.2% children with sensory over-responsivity did not have a co-morbid psychiatric diagnosis while 68.3% of the children did have a co-morbid diagnosis of sensory over-responsivity and a psychiatric diagnosis. The authors also determined that the children who were positive for only sensory over-responsivity without a co-morbid psychiatric diagnosis showed no difference from typical children in terms of their rates of physical health problems. The authors suggest a genetic source for the comorbidity of sensory over-responsivity and psychiatric diagnosis. This suggests that children with SPD do not have a generalized increase in the rate of health problems, and the findings of this study introduce a possible link between SPD and DES.

Research is certainly needed to clarify causation between DES and SPD or shared causation for DES and SPD. It has already been suggested that despite lack of identifiable neurologic lesions, DES may have some neurological cause (Leclair & Heloury, 2010). Future studies might test if there are links between the autonomic nervous system dysfunction, DES and SPD.

Limitations

Several limitations are to be acknowledged in the interpretation of these findings. This includes the study group sample size. Also, the differences in age between the study and control group could be a limitation. Not having collected data regarding age of toilet training in the study group was a limitation in our ability to compare the two groups on this factor. Our first
hypothesis used the rate of SPD found by Ahn et. al. (2004). The limitation here is that to the
study sample used by Ahn et. al. (2004) was of children entering kindergarten, which is a
younger sample than both groups of children included in this study. Even still, the rate of SPD in
the study sample reported here is notably high and cannot be accounted for by regional patterns.

The method of data collection also introduces some limitations. The information
provided through parent report could be inaccurate. For the control group, parents completed
surveys without a researcher present who could immediately answer any questions the parent
may have about completing the surveys. It is possible that parents did not fully understand the
questions on the Vancouver NLUTD/DES Questionnaire and or the Short Sensory Profile to give
an accurate answer. Also, the Vancouver NLUTD/DES Questionnaire did not always provide
the range of answers appropriate for the parent which may have caused the parent to circle more
than one answer per item. In both groups, some participants provided incomplete data.
Diagnostic categorization of DES or SPD would have been unchanged with complete
information, so the results from the nonparametric binomial and the Chi-square analyses were
not likely affected by this; however, the correlation analysis may have been affected. Also,
staffing changes at the study site unintentionally meant that not every child who met the
inclusion criteria was offered the opportunity to participate in this research.

Another limitation is that the Vancouver NLUTD/DES Questionnaire is a newer
instrument without evidence of use in other published research; therefore, its psychometric rigor
has not been firmly established. The reason this instrument was used was because the other
current instruments used in research to diagnosis DES do not address symptoms of encopresis,
which accompanies DES.
Finally, it is possible that parents of children in the study group demonstrated a negative response bias in completing the questionnaires. Perhaps the stress that their child’s bowel and bladder difficulties place on daily life caused them to view their child as being more difficult, sensitive, or stubborn resulting in a higher rate of endorsing symptoms of SPD. Negative perspective of children with toileting dysfunction has been shown previously (Schonwald et al., 2004; Burkett et al., 2006; Joinson, et al., 2004).

**Future Studies**

Future studies could address the relationship of DES and SPD from the opposite perspective by investigating whether children who are in treatment for SPD also have a higher rate of DES. Another area of study would be to test SPD-based treatment for DES. For example, the SSP could be used to determine the areas of sensory sensitivity or disorder that show non-typical performance for children in treatment for DES. Assessment results could be used to determine a treatment plan that would address the sensory areas of non-typical performance as well as the DES. Future research could determine if the treating both DES and SPD simultaneously could result in increased effectiveness of current treatment protocol for DES. Finally, future research is needed to clarify causation and or shared causation for DES and SPD.

**Implications for Occupational Therapy**

Treatment for DES varies greatly. Current treatment for DES includes: use of bladder retraining (to frequently and fully empty the bladder), use of laxatives or stool softeners, scheduled voiding, and dietary changes such as high fiber diets and hydration (Canadian Urological Association, n.d.; Kurzrock, & Wagner, n.d.). Other techniques include animated biofeedback and pelvic floor exercises (Kajbafzadeh et al., 2011) and sacral nerve stimulation (Roth et al., 2008). However, no current treatments for DES address sensory issues.
Obtaining bowel and bladder control is a self-care occupation that increases a child’s independence and their access to social and educational opportunities. Occupational therapy has the goal of increasing children’s independence and competence within a given environment. Occupational therapists could play a role in working with children who present to urological offices for DES. Given the high rate of SPD among those with a diagnosis of DES, an occupational therapist could help to determine a treatment program that could account for the child’s sensory concerns. For example, the SSP has seven sub-sections. Four sections address sensitivity in the areas of touch, smell, movement, and visual and auditory. Other sections address auditory filtering, low energy level or weakness and seeks sensation or underresponsive. For example, a child may have a definite difference in taste/smell sensitivity that may be contributing to using a toilet. This child may avoid using public bathrooms due to offensive odors and may be bothered by the smells associated with toileting. Strategies could be used with this child to decrease the olfactory input with toileting such as maintaining a clean bathroom, providing them something to hold to their nose while defecating, flushing the toilet frequently to remove the smell, and acknowledging that the child may refuse public restrooms as a result of SPD rather than attributing the child’s refusal as defiant behavior. Similarly, a child with auditory filtering difficulties may find it difficult to use the toilet when there are loud or unfamiliar noises such as a fan, power-flush toilets, or commercial, hot-air hand dryers found in public restrooms. Again, a child’s sensitivity to sound could be accounted for in a treatment plan, which could include flushing the toilet for the child while the child covers their ears and foregoing the fan. In the case of a child who is underresponsive he/she may not detect the need to defecate or urinate. He/she may need some kind of reminder or schedule to attempt toileting.
A child who seeks sensation may be too busy engaging in the environment to notice his/her own bodily sensations that are signaling him/her to stop and use the bathroom.

Another role for the occupational therapist is to educate pediatric urologists so that they are aware of the potential co-morbid diagnosis of SPD with the child’s DES. This education would describe on SPD and how it could be affecting the child’s toileting behaviors. Expanding the role of the occupational therapist to take a more active role in children’s toileting based on therapists understanding of SPD could help to further educate parents and other pediatric practitioners. Likewise, it is possible that there is a role for the occupational therapist in the pediatric urology setting.

Furthermore, occupational therapists should be made aware that the children they are treating for SPD could also have concerns with DES. Occupational therapists should be informed about the signs and symptoms of DES and know to refer children in their practice to a pediatric urologist to manage the DES. Finally, given that occupational therapy addresses occupations of daily living including toileting, it is surprising how limited the literature is on the topic of pediatrics and toileting within the field of occupational therapy. This research reinforces the opportunity that exists for occupational therapists to take a more active role in helping children obtain the self-care skill of toileting. Occupational therapists may encounter children who have DES within a variety of settings including a pediatric urology office, outpatient settings, early-childhood intervention programs and in the school-based setting.

**Conclusion**

Because elimination disorders have a significant impact on children and their families, expanding the understanding of how to develop a successful treatment plan that is client-centered is significant. Dysfunctional elimination syndrome has an unclear etiology. Much research has
been conducted to gain a better understanding of the characteristics of the syndrome. Likewise, research has examined other potential contributing environmental factors as well as behavioral and emotional factors displayed by children diagnosed with DES. This study found that a majority of children with DES also presented with SPD. Understanding a child’s unique sensory processing can help practitioners and parents view DES from another perspective. When taking into account a child’s SPD profile, it may be possible to have a greater understanding of the child’s toileting behaviors.
Acknowledgments

This research began with a question posed to Dr. Metz by Theresa Barabash, RN, NP and Melissa Kurtz, RN, BSN who work in the Pediatric Urology office at St. Vincent Mercy Medical Center. They were curious to know if the children they were seeing for DES also had issues with sensory processing. I am grateful for their willingness to allow me to investigate this question with them as part of my graduate scholarly project. Theresa Barabash was instrumental in collecting data for the study group and I am thankful for her efforts.

A control group for this research would not have been possible without the support of community partners who facilitated that data collection. I would like to thank Wood County Medical Associates and in particular Marjean Beck, CNP for her willingness to take on the extra work of distributing research packets to eligible participants who came to the office for their yearly well-visit. Janell Arps, CNP also helped to distribute packets at this site. In addition, I would like to thank the University Pediatrics at The University of Toledo Medical Center, which also distributed research packets to eligible participants. In particular, I appreciate the support of Thomas Russell, RN, MSN Clinic Manager of Pediatrics at UTMC for his willingness to support student research and for facilitating the collection of data with his staff.

Finally, I would like to thank Dr. Metz for her continuous efforts and thoughtfulness in reviewing the progress and supporting the completion of this scholarly project.
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Table 1. Participant Demographics

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Study Group (n=19)</th>
<th>Control Group (n=55)</th>
</tr>
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<tbody>
<tr>
<td>Age</td>
<td>8.3±1.5 years</td>
<td>6.9±1.7*</td>
</tr>
<tr>
<td>Sex</td>
<td>12 male, 7 female</td>
<td>31 male, 24 female</td>
</tr>
<tr>
<td>SES</td>
<td>35±12</td>
<td>41±14*</td>
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*Differences are significant at the p<0.05 level
†One participant did not complete the SES questionnaire
Table 2. Distribution of DES and SPD

<table>
<thead>
<tr>
<th></th>
<th>DES</th>
<th>Not DES</th>
<th>Total</th>
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<tbody>
<tr>
<td>SPD</td>
<td>13 (17.6%)</td>
<td>1 (1.4%)</td>
<td>14 (18.9%)</td>
</tr>
<tr>
<td>Not SPD</td>
<td>16 (21.6%)</td>
<td>44 (59.5%)</td>
<td>60 (81.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>29 (39.2%)</td>
<td>45 (60.8%)</td>
<td>74</td>
</tr>
</tbody>
</table>
Correlation Between SSP and DES Scores for Combined Study and Control Groups (n=74, Spearman’s ρ = -0.493, $R_s^2 = 0.243$, $p<0.001$). For the SSP, scores ≤141 fall in to the range of definite difference. For the NLUTD/DES, scores ≥11 are indicative of DES.