



Published in final edited form as:

J Pediatr Gastroenterol Nutr. 2013 February ; 56(2): 156–160. doi:10.1097/MPG.0b013e3182736e19.

Sensory processing issues in young children presenting to an outpatient feeding clinic: A retrospective chart review

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Abstract

Objectives—To describe the relationship between sensory issues and medical complexity in a series of patients presenting to an outpatient multidisciplinary feeding team for evaluation, by a standardized measure of sensory processing abilities.

Methods—A retrospective chart review of all patients seen from 2004–2009 on two key variables; medical diagnostic category and Short Sensory Profile (SSP) score.

Results—On the SSP, 67.6% of children scored in the clinical (“Definite difference”) range. The most common diagnostic categories were Developmental (n=23), Gastrointestinal (n=16) and Neurological (n=13). Behavioral and Cardiorespiratory medical diagnostic categories were significantly related to SSP total score and SSP definite difference score.

Conclusions—Children who present for feeding evaluation do indeed tend to have clinically elevated scores regarding sensory processing, and these elevated scores are significantly related to certain medical diagnostic categories. Future research is needed to determine why these significant relationships exist as well as their implications for treatment of feeding related issues.

Keywords

Feeding; Sensory Processing; Diagnostic Categories

Introduction

Feeding is one of the most important early skills that a child must learn, and the development of feeding skills is extremely complex and multifactorial (1). Many parents express frustration over young children being “picky eaters,” and feeding issues frequently become a struggle for families (2). “Picky eating” and other mild forms of feeding problems do not typically progress into serious feeding difficulties. Mild feeding difficulties occur in up to 25–45% of healthy children and 80% of children with developmental delays or chronic disease (3,4). Serious feeding difficulties requiring medical intervention occur in 3–10% of children (4). Premature infants are overrepresented among children with serious feeding

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Conflict of Interest Disclosure: None to declare

Declaration of Funding Source Statement: None to declare.

difficulties (5), and improved preterm infant survival has increased the prevalence of feeding problems in older infants and toddlers (6). In addition, severe feeding problems may be more common in children with chronic medical conditions, occurring in 40–70% of this population (7,8).

Feeding difficulties are caused by structural abnormalities, neurological problems, cardiac conditions, behavioral problems, and respiratory conditions, along with gastrointestinal motility and sensory abnormalities (9,10). The most common medical diagnostic categories of children presenting to a feeding team include neurological (62%), mechanical/structural (53%), behavioral (43%), cardiorespiratory (34%) and metabolic (12%), with most children falling into two or more diagnostic categories simultaneously (11). Children referred to a feeding team are often medically complicated (11). Neonates with long intensive care hospitalizations may lose opportunities for learning to eat and may associate eating with pain or discomfort (10). Premature infants are also more likely to present to a feeding team than children born at term (11). Gastrostomy and gastro-jejunal tube feeding requirements may persist for months or years, resulting in chronic oral food refusal. As the prevalence of gastrostomy tube feeding has increased, so have the challenges associated with transitioning a child from tube to oral feeding (12,13).

Along with medical issues, sensory issues also affect feeding. Senses of smell, taste, touch, proprioception, vision, hearing, and sound filtering all contribute to the information the brain has to process and analyze during the feeding experience (14). Interactions between and within sensory modalities are very relevant to food perception (15). During eating, some sensations are regarded as important and relevant, while others must be ignored. Specifically, researchers have found that smell (odor) can increase the intensity of taste (16). Touch represented as viscosity also decreases both sensitivity to (17–19) and intensity of (20–25) the four basic taste groups. Moreover, temperature of food between 22–37° C sets taste thresholds at minimum for salt (26,27) as well as acid (HCl), bitter (quinine sulfate) and sweeteners (like dulcin) (27). Visual sense, with color as its main parameter, increases taste threshold and decreases taste discrimination (28–30). Red color enhances the sweet taste intensity in aqueous solutions (31).

The perceived quality and intensity of such sensations affect the brain's ability to set priorities for current focus versus things to ignore. Too much stimulation may draw the infant's attention and response towards a particular stimulus source rather than focusing on the other processes associated with eating, such as chewing or swallowing. Thus, problems affecting children's abilities to handle and process such multiple sensory stimuli render them susceptible to feeding problems or could complicate some pre-existing feeding issues.

Surprisingly, there have been very few studies regarding the relationship between sensory issues and feeding within clinical populations. In the only published study, Rommel and colleagues (2003) describe 700 children under 10 years of age who presented with feeding problems in a Belgian, multidisciplinary outpatient clinic (5). The purpose was to characterize the etiology of the feeding difficulties as medical, oral or behavioral. Although they did assess for sensory issues, they relied on the clinical judgment of a Speech and Language Pathologist rather than using a standardized measure. Results indicated that oral/medical problems were the major contributing factors for feeding issues in children less than 2 years of age, while behavioral issues were the most prevalent after 2 years of age. The oral sensory-based feeding disorders corresponded with past medical intervention and nasogastric or gastrostomy tube feeding.

Despite strong evidence of a relationship between sensory issues and feeding problems, there has been no global look at sensory issues faced by children who present to an

outpatient multidisciplinary feeding team using a standardized measure of sensory processing abilities. The purpose of this study was to describe the relationship between sensory issues and medical complexity in a series of patients presenting to an outpatient multidisciplinary feeding team for evaluation, using a standardized measure of sensory processing abilities.

Materials and Methods

Patients were all children who presented at the University of Kansas Medical Center's multidisciplinary outpatient feeding clinic between 2004 and 2009. The feeding team consists of a physician, psychologist, dietician, and occupational therapist who see the patients simultaneously for an initial evaluation (and later for treatment, as appropriate). Patients are referred and refer themselves, and the purpose of the clinic is to help all children reach their full capacity regarding oral self-feeding. The parents of children who attend clinic for an initial evaluation are asked to complete several measures, one of which is the Short Sensory Profile. This retrospective chart review and all methodology for the study were approved by the Human Subjects Committee.

Short Sensory Profile (SSP)

The Short Sensory Profile is a 38-item caregiver-report measure designed to assess sensory processing problems in children 3–10 years of age (32). It takes approximately 10 minutes to complete and has been recommended for research protocols (33). Items are scored on a 5-point scale with higher scores indicating more impairment. The seven subscales of the SSP are Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Under-Responsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, and Visual/Auditory Sensitivity. Scores result in categorizations of Typical, Probably Difference (meaning the child's scores are more problematic than a typical child), and Definite Difference (meaning that the child's scores are in the clinical range). Internal consistency of the subscales ranges from .70 to .90 (33), and the measure has a reliability of .90 and discriminant validity >95% in identifying children with and without sensory modulation dysfunction (32). The total score is the best indicator of overall sensory dysfunction (32).

Medical Diagnostic Category

Patient charts were reviewed and all medical diagnoses were noted in a research database. These diagnoses were then independently categorized by two trained coders into five medical diagnostic categories and agreement was assessed. Medical diagnostic categories included neurological, developmental, gastrointestinal, behavioral and cardio-respiratory (see Table 2). Categories are not mutually exclusive, because a patient can have more than one diagnosis. These methods and categories have been previously validated (34).

Analyses

All statistical analyses were performed using the Statistical Package for the Social Sciences (PASW Statistics, v18.0.3). Inter-rater reliability of medical diagnostic category was calculated using the Kappa statistic. To begin, summary statistics were run on all SSP scores and on medical diagnostic categories. Because medical diagnostic categories were not mutually exclusive, a stepwise linear regression was run with SSP total score as the dependent variable and the five medical diagnostic categories as independent variables. To compare the SSP subscale scores by medical diagnostic category, a series of stepwise linear regressions were run with each subscale score as the dependent variable and medical diagnostic categories as the independent variables. A series of Pearson product-moment correlation coefficients were computed to assess the relationship between medical diagnostic category and "definite difference" scores on the SSP. Because some children fell outside the

recommended age range for the SSP, a one-way Anova was run on the SSP Total score between children who were under the age of three and children who were over. There was not a significant difference between these two groups, ($F = .011$, $p = .916$) so children of all ages were included in the paper.

Results

During the study period, 65 children over the age of 3 years attended a new clinic visit for a feeding team evaluation and had complete baseline measures and all were accepted into the current study. Children were an average of 45.77 months of age ($SD = 33.83$) and 23 of them were female (35.4%). See Table 1 for more information.

Short Sensory Profile (SSP)

Twelve children (18.5%) had total scores in the typical range on the SSP, nine scored in the probable difference range (13.8%), and 44 (67.6%) in the definite difference range. Results for the overall sample on the total sensory score, subscale scores, and by medical diagnosis are presented in Table 3.

Medical Diagnostic Categories

Agreement between coders of medical diagnostic categories was acceptable ($Kappa = .89$) and disagreements were resolved to arrive at the final coding used for analyses. Results indicate that 11 children (16.9%) did not have a medical diagnosis at the time of the initial appointment with the feeding team, necessitating further assessment. Thirty-three (50.8%) had one diagnosis, 19 (29.2%) had two diagnoses, and 2 (3.1%) had three diagnoses, indicating this was a medically complicated population. The most common diagnostic category was Developmental ($n=23$), followed by Gastrointestinal ($n=16$) and Neurological ($n=13$; Table 2).

SSP Total Score by Medical Diagnostic Category

The stepwise multiple linear regression with SSP total score and the five medical diagnostic categories indicated that two diagnoses (Behavioral, Cardiorespiratory) explained a proportion of the variance that approached significance in SSP total score, $R^2 = .048$, $F(1,63) = 2.612$, $p = .081$. As can be seen in Table 3, the percentage of subjects with Definite Difference scores on the SSP did differ by medical diagnostic category, with the highest being Cardiorespiratory (91.7%), Behavioral (71.4%), and Gastrointestinal (70.6%). There was a significant relationship between SSP Total Definite Difference Score and Cardiorespiratory Diagnosis ($r = .206$, $p = .050$) and Behavioral Diagnosis ($r = -.291$, $p = .009$). Medical Diagnosis by Difference Score is displayed in Table 4.

SSP Subscale Scores by Medical Diagnostic Category

Analyses on subscale scores indicated that for the Tactile subscale, two diagnoses (Cardiorespiratory, Developmental) explained a significant portion of the variance, $R^2 = .154$, $F(2,64) = 5.629$, $p = .006$. For the Taste/Smell subscale, only Cardiorespiratory loaded significantly, $R^2 = .114$, $F(1,64) = 8.137$, $p = .006$. None of the other domains (Movement, Under-responsive, Auditory, Low energy/Weak, Visual/Auditory) loaded significantly onto diagnostic category.

Discussion

This study is the second to examine the possible co-occurrence of feeding problems and sensory issues in a pediatric sample, and the first to do so using a standardized measure of sensory processing, the Short Sensory Profile (SSP). Our sample of children presenting for

evaluation at an outpatient multidisciplinary feeding clinic was medically complicated (32.3% had more than one diagnosis), which is consistent with previous reports (11). Other studies using the same medical diagnostic category coding scheme, however, have found differences in terms of the most common diagnostic categories. Our results indicate that the most common categories were Developmental, followed by Gastrointestinal and Neurological, whereas previous research has suggested the most common categories were Neurological, followed by Mechanical/Structural and Behavioral. The reason for these differences is unclear but could be influenced by such factors as referral sources, variability in practices on the Neonatal Intensive Care Units and other services that provide care for these children, as well as variability in services available at different sites. For example, there is a well-known developmental screening and referral program co-located with our team, which could lead to a higher rate of Developmental diagnoses at our site compared to the previous study.

Our study also found that a significant number of children presenting for a feeding evaluation had clinically significant scores on the Short Sensory Profile (67.6% of children had SSP scores in the definite difference range). The only previous study assessing sensory issues in children presenting for a feeding evaluation (5) suggested that 61% of children had an “oral diagnosis.” Given the fact that the “oral diagnosis” was based solely on clinician judgment and not using a standardized measure, it is surprising how close these two rates are and speaks to the clinical relevance of the SSP, and in particular a definite difference categorization on the total score. The previous study also indicated some differences in findings by age (5), but no such age differences were found in the current study, either for SSP total score or for medical diagnostic category.

Regarding the relationship between medical diagnostic category and the Short Sensory Profile (SSP), our results indicate that the diagnostic categories of Behavioral and Cardiorespiratory were significantly related to SSP total score, as well as to the SSP definite difference score. This suggests that difficulties in sensory processing are significantly related to behavioral feeding problems such as dysfunctional feeder-child interaction, purposeful spitting at meals, and other behaviors that interfere with typical feeding development. Because this is the first use of a standardized measure like the SSP with a feeding population, it is not possible to compare these findings to previous research. Clinical judgment, however, would suggest that difficulties in sensory processing that are missed could lead to significant behavioral problems around mealtime, particularly as well-meaning therapists and caregivers attempt to coax the child to eat using typical feeding practices that are not sensitive to the child’s existing sensory issues.

Our results also suggest that difficulties in sensory processing are significantly related to cardiorespiratory problems such as Asthma, Bronchopulmonary dysplasia, or Pulmonic stenosis. Medicine has long been aware of the complicated, coordinated suck-swallow-breathe pattern required for oral eating (15). It is possible, and in fact likely, that children with cardiorespiratory problems are more likely to have difficulty navigating this suck-swallow-breathe pattern, which would lead to problems with choking, which definitely inhibits typical feeding development and, as our results would suggest, may also lead to increases in sensory processing problems.

Looking at the SSP subscale scores, our results suggest that only two subscales (Tactile and Taste/Smell) were significantly related to medical diagnostic category. In particular, Tactile was related to Cardiorespiratory and Developmental, and Taste/Smell to Cardiorespiratory alone. Given that Cardiorespiratory was one of the diagnostic categories most related to SSP total score, it is interesting to note that it is the only medical diagnostic category related to two subscales – Tactile and Taste/Smell. Unfortunately, the larger literature does not help to

explain this finding. There have been studies of the SSP with autistic children (35,36), children with attention-deficit hyperactivity disorder (37), and children with learning disabilities (38), but no reports of the SSP in children with other medical issues that might explain these subscale findings. Future research is needed to determine why there is a relationship between certain SSP subscale scores and certain medical diagnoses (for Tactile, Cardiorespiratory and Developmental, and for Taste/Smell, Cardiorespiratory).

Limitations

Our study does not come without limitations. First, it is a study of children presenting for evaluation – a unique group of children among all those with feeding problems. Second, the children were all presenting at a single site, which may have resulted in unique referral patterns or other biases. The age range of the children may be considered larger than typical, given the standard deviation in our age range. A definite strength of the study is the use of the Short Sensory Profile, a validated and reliable measure of sensory processing in young children. The SSP is a caregiver-report measure, however, which some may see as a weakness as it relies on the parent to report their perspective. However, in this case it was the best measure available of sensory issues in children presenting to a feeding clinic. Parent report of problems is also important to consider as it drives treatment seeking and other key behaviors, and research has shown that parents are reliable and valid reporters of their child's behaviors (39). Although our study did have the necessary power to detect significant differences between groups, our sample was somewhat small, so larger studies should be conducted in the future. Finally, our sample size was sufficient for all analyses conducted, but was not large enough to allow for item-by-item analyses, something which might be useful (35).

In summary, this first analysis of the Short Sensory Profile in a group of children with feeding problems suggests that their feeding issues do indeed correlate with elevated scores of sensory processing, and that elevated scores are significantly related to certain medical diagnostic categories (Behavioral, Cardiorespiratory). Future research needs to examine why children who fall into certain medical diagnostic categories are more/less impaired regarding sensory processing, as well as why children who fall into certain medical diagnostic categories are more/less impaired in specific areas of sensory processing such as Tactile or Taste/Smell. As most feeding programs have inpatient, day-treatment and outpatient programs, it would also be interesting to compare sensory processing problems across these different treatment venues and to look at the relationship between sensory processing difficulties and outcome of treatment of feeding issues. For practitioners who work in feeding teams, these results imply that having a truly multidisciplinary approach that incorporates sensory assessment into typical clinical care is recommended, as many of these children are facing sensory issues that likely impact their feeding development.

Acknowledgments

The authors thank Dr. John Belmont for his statistical guidance and also acknowledge funding from the National Institutes of Health (DK068221 and HD066629 to the first author).

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Table 1

Demographics of participants.

Age in months (<i>M, SD</i>)	45.77 (33.83)
% female (<i>n</i>)	35.4 (23)
Medical Diagnoses ^{<i>1</i>} <i>n</i> (%)	
Neurological	13 (20)
Developmental	23 (36)
Gastrointestinal	16 (25)
Behavioral	9 (14)
Cardio-Respiratory	12 (18)
None	11 (17)

^{*1*}These categories are not mutually exclusive.

Table 2

Examples of conditions from each medical diagnostic category.

Medical Diagnostic Category	Example Conditions
Neurological	Brain stem injury, Cerebral palsy, Cranial stenosis, Down Syndrome, Hypotonia, Infantile Spasms, Meningomyelocele, Neuroblastoma, Oral-facial-digital syndrome, Periventricular leukomalacia, Prader-Willi
Developmental	Downs Syndrome, Autism Spectrum Disorder, Asperger's, Developmental delay
Gastrointestinal Behavioral	GERD, Reflux, Motility disorder, Esophageal Atresia Unpredictable mealtime schedule, Dysfunctional feeder-child interaction, Selective food refusal, Purposeful spitting, gagging and vomiting at meals, Throwing food at meals
Cardio-respiratory	Asthma, Bronchopulmonary dysplasia, Noonan Syndrome, Obstructive lung disease, Pulmonic stenosis, Respiratory distress syndrome, Tetralogy of Fallot

These categories are not mutually exclusive and do not encompass all conditions coded in the current study.

Table 3
 Results of Short Sensory Profile for Total Sample and by Medical Diagnostic Category. Data are \bar{M} (SD).

Total (n=65)	Neurological (n=13)	Developmental (n=23)	Gastrointestinal (n=16)	Behavioral (n=9)	Cardiorespiratory (n=12)	No Diagnosis (n=11)
Total sensory score	128.15 (33.63)	122.61 (34.87)	128.69 (25.76)	135.11 (29.61)	114.00 (31.91)	121.64 (45.39)
Tactile	25.42 (7.24)	23.14 (7.97)	26.88 (5.94)	23.89 (9.48)	20.08 (7.54)	26.36 (7.87)
Taste/Smell	9.26 (5.33)	8.48 (5.11)	9.81 (5.32)	8.00 (4.21)	5.50 (4.70)	9.91 (5.77)
Movement	13.23 (3.78)	11.57 (4.35)	12.88 (3.48)	13.78 (2.99)	11.18 (4.96)	12.10 (3.69)
Under-responsive	22.42 (8.01)	24.31 (7.87)	19.69 (9.15)	22.44 (10.44)	23.50 (6.42)	22.50 (8.95)
Auditory	20.20 (6.46)	19.74 (6.84)	20.63 (5.97)	21.78 (4.09)	19.67 (5.68)	18.55 (8.04)
Low energy/Weak	20.44 (9.23)	18.57 (9.19)	22.19 (7.92)	24.89 (8.54)	16.75 (10.27)	18.82 (10.97)
Visual/Auditory	17.02 (5.28)	16.83 (5.94)	16.38 (4.83)	17.67 (5.59)	17.58 (6.08)	16.09 (7.04)

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Table 4

Definite difference scores by medical diagnostic category.

SSP Total Difference Score	Medical Diagnostic Category					
	Neurological (n = 13)	Developmental (n = 23)	Gastrointestinal (n = 17)	Behavioral (n = 7)	Cardiorespiratory (n = 12)	No Diagnosis (n=11)
Typical	3 (23.1)	3 (13.0)	3 (17.6)	0	1 (8.3)	4 (36.3)
Probable Difference	1 (7.7)	5 (21.7)	2 (11.8)	2 (28.6)	0	2 (18.1)
Definite Difference	9 (69.2)	15 (65.2)	12 (70.6)	5 (71.4)	11 (91.7)	5 (45.5)