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Feeding behaviors and the child with posterior tongue-tie : comparison to norms.

McKenzie Sexton
University of Louisville

FEEDING BEHAVIORS AND THE CHILD WITH POSTERIOR TONGUE-TIE: COMPARISON TO NORMS

By

McKenzie Sexton

B.A.- University of Louisville, Louisville, KY, May 2016

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A Thesis Approved on
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by the following Thesis Committee:

_____
Teresa Pitts, Ph.D., Thesis Director

_____
Rhonda Mattingly, Ed.D, Thesis Mentor

_____
Alan Smith, Ed.D., Committee Member

DEDICATION

To my thesis committee, my family, and my inspiration for pursuing this career,

Cole Santiago Quintela, thank you.

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ABSTRACT

FEEDING BEHAVIORS AND THE CHILD WITH POSTERIOR TONGUE-TIE: COMPARISON TO NORMS

McKenzie E. Sexton

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The tongue is an important muscle used in speech, mastication, swallowing, and breastfeeding. It plays an important role in facial development, dentition, and periodontal status. Posterior ankyloglossia, also known as posterior tongue-tie (PTT), is characterized by a tether beneath the lingual mucosa. Upon visual inspection, the frenulum is non-prominent but with the use of a grooved director it may appear abnormally prominent, short, thick, or cord-like. Palpation of the frenulum may reveal tightness. There is a lack of empirical data about PTT and the impact on feeding beyond early infancy. PTT is not well recognized and can be missed resulting in delayed management. The development of feeding skills is linked to early experiences and is highly relational between a child and his or her caregiver. Undiagnosed or poorly managed conditions that influence early feeding and/or child and parent interaction may have long lasting effects on nutrition outcomes. The purpose of this study is to use the *Behavioral Pediatric Feeding Assessment Scale* (BPFAS) to determine whether children with PTT have more

frequently occurring feeding behaviors and the degree to which those behaviors are considered problematic when compared to normative data. Examination of the impact of late diagnosis and late management on behaviors and the relationship between child and parent actions was also performed.

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INTRODUCTION

Posterior ankyloglossia, also known as posterior tongue-tie (PTT), has been studied extensively as it pertains to neonates and infants, but is research is lacking for ages beyond early infancy (Ballard, Auer, & Khoury, 2002; Knox, 2010; O'Callahan, Macary, & Clemente, 2013). The development of feeding skills is linked to early experiences and is highly relational between a child and his or her caregiver. Research exists about the manner in which parent-child feeding relationships affect feeding behaviors and scales have been developed based on work in this area (Satter, 2000). The purpose of this study is to use the *Behavioral Pediatric Feeding Assessment Scale* (BPFAS) to determine whether children with PTT have more frequently occurring problem feeding behaviors and the degree to which those behaviors are considered problematic when compared to normative data.

Typical Feeding Development

For the first four months after birth, feeding is largely reflexive as evidenced by the presence of the rooting, the suck-swallow-breathe, the phasic bite, and the gag reflex (Overland, 2011). During the first month after birth, the neonatal period, feeding is characterized by a lack of dissociative movement, as the tongue, lips, and jaw all work together (Delaney & Arvedson, 2008, p. 34). The tongue is cupped during feeding, breathing is through the nose, and the lips create a passive seal, supporting pressure gradient. The direction of lingual movement in early infancy is anterior to posterior

which is sometimes referred to as suckling but with anatomical changes and maturation the pattern becomes more up and down which is termed sucking. Infant feeding behaviors begin as periods of hunger and satiety in conjunction with irregular wake and sleep periods (Arvedson & Brodsky, 2002). During the neonatal stage, posturing is characterized by learning to control the body against gravity, weight bearing in a prone position, moving the head side-to-side in supine position, and physiologic flexion to maintain the pharyngeal airway (Delaney, 2008).

Developmentally, two to six months is termed the infancy period. The first four to six months, the infant gains nutrition solely through breast milk or formula through nipple feedings. At two months of age, infants gain better range of jaw movement, have better lip closure, and continue to demonstrate a suckling pattern characterized by anteroposterior motion of the tongue (Arvedson, 2002). Within the first three months, an infant begins to self-regulate as sleep-wake and hunger-satiety periods become more regular. Infants usually complete an oral feeding of five to seven ounces in 20 to 30 minutes at three months of age (Delaney, 2008). By four months of age, the infant gains voluntary control of the of the mouth, allowing for dissociation of the lip and tongue and increased sound imitation (Arvedson, 2002). At five months, infants begin holding the nipple with the center portion of their lips with balance and stability, maneuvering the tongue in a small up-down movement. As liquids and purees are introduced during spoon feedings at this stage, the tongue can reverse after a spoon is removed, which ejects the bolus immediately. During spoon feedings, a munch-chew and a sucking pattern also emerge, and the infant may gag on new textures (Arvedson, 2002; Overland, 2011). At six months, the infant begins to incorporate a wide range of up-down, forward-back

tongue and jaw movements and semi-solids given by spoon may be pushed out of the mouth. There is an increase in teething, active oral exploration with toys and other objects, and longer periods of lip closure. The rooting reflex and automatic bite release are integrated, and the gag reflex is diminished (Arvedson, 2002).

The stage of development between seven and nine months is known as late infancy. During this time, an infant begins to crawl on his or her belly, gain trunk control, and initiate movement from the pelvis and upper extremities. Feeding during this stage is characterized by the movement of the gag reflex from the front third of the tongue to the back third, drooling during teething, cup drinking using the lower lip as a stabilizer, and moving the lateral tongue to touch solids while the upper lip cleans the bolus from a spoon (Arvedson, 2002; Overland, 2011). The jaw has the ability to move separately from the tongue and lips during biting, and the tongue makes lateral movements to transfer food side-to-side and to the center of the mouth (Delaney, 2008).

Between 10 and 12 months of age, a child gains full range of motion of the upper extremities, begins to change position of the lower extremities independent of the upper body, can stand independently, and begins learning how to walk (Arvedson, 2002). The ability to finger feed emerges and increasing coordination of jaw, tongue, and lip movements in all positions is developing. The gag reflex moves from the back third of the tongue to the pharyngeal wall (Overland, 2011)The child starts to wean from the nipple as cup drinking increases with improved lip closure and coordination with liquids, and he or she easily closes his or her lips on a spoon and utilizes the lips in removing food from the spoon (Arvedson, 2002; Overland, 2011).

From 13 to 18 months of age, the child begins walking alone, using stairs, scooping food to the mouth, and grasping and releasing with precision. The child demonstrates fully coordinated swallowing and breathing during feeding. At this stage, all textures should be accepted, straw drinking begins, chewing occurs with up-down and diagonal rotary movements, and lateral tongue motion increases(Arvedson, 2002; Overland, 2011).

Equilibrium improves from 19 to 24 months of age. The child swallows with lip closure, up-down tongue movement is precise, and self-feeding predominates during meals with independent food intake. Rotary chewing is dominant with improved efficiency with solid foods (Arvedson, 2002).

Throughout 24 to 36 months in development, the child begins to jump in place, use scissors, pedal a tricycle, and refine the skills. The child utilizes circulatory jaw rotations, lip closure with chewing, and one-handed holding of an open cup without spilling. He or she demonstrates the ability to fully self-feed using a fork, fill a spoon with use of his or her fingers, and eat solids (Arvedson, 2002).

In typical feeding development, children explore their food through trial and error, smashing, crashing, and trashing foods. This can only develop in a safe environment where threats do not exist and repeated opportunities are given to experience new foods (Birch, 1999). If a child cannot eat, drink, and explore safely, feeding and behavioral problems may occur (Chatoor & Ganiban, 2003). Feeding problems such as food refusal before one year of age may foreshadow serious eating problems at four and six years of age (Dahl, Rydell, & Sundelin, 1994). One such eating problem is called selective food refusal or sensory food aversion. In this diagnosis, an infant or child will

refuse foods based on tastes, smells, or textures. This can mean that the child refuses whole groups of foods (e.g., meats, vegetables, fruits) (Chatoor & Ganiban, 2003). If a child feels a lack of control when eating or has had issues with eating in the past, he or she can develop fears around feeding that cause food aversions. Children who had repeated traumatic events to the oropharynx or esophagus such as choking, vomiting, reflux, or force feeding may begin to self-limit due to a feeling of danger, and may stop eating foods that require chewing and may exhibit anxious behaviors around mealtime (Chatoor, Ganiban, Harrison, & Hirsch, 2001). Therefore, for typical progression, multiple factors including a feeling of safety and the ability to explore must be present during each stage of feeding development.

Parent and Caregiver Role in Feeding Development

Parents and children both have responsibilities in feeding, which should result in a give-and-take exchange where the parent or caregiver helps the child learn eating skills alongside positive eating attitudes and behaviors (Satter, 2000, 2015). Satter (2000) states that the division of responsibilities between parent and child changes over time. In feeding, infants are responsible for *how much,* whereas parents are responsible for *what* foods are eaten. For example, a mother can offer breast milk or formula to an infant, and the infant chooses whether to eat at all or to stop eating when full. As the child matures, the division of responsibility changes (Satter, 2000). The parent is responsible for *what, when,* and *where* feeding takes place. The toddler is responsible for *how much* and *whether* he or she eats. A large portion of the parent's role in feeding is trusting the child with *how much* and *whether* to eat (Satter, 2000, 2015). Arvedson (2002) outlines the parent's role in feeding beyond infancy as setting the schedule, arranging the

environment, and determining the procedure for meals. Scheduling relates to having regular mealtimes with only planned snacks. The atmosphere should be free of force feeding. The procedure should include the presentation of smalls portions, solids first followed by fluids, and encouraged self-feeding (Arvedson, 2002). Parents' actions around mealtime can alter a child's eating behaviors. Caregiver feeding styles can be categorized as responsive, controlling, indulgent, or neglectful (Satter, 2000). Caregiver feeding style can be influenced by cultural norms, parental concerns, and child characteristics (Kerzner et al., 2015). Responsive is the preferred feeding style, as it allows for infants to self-regulate their feedings. If a parent or caregiver is responsive to an infant's feeding signals and they present food so that their infant or child can take it easily, then the feeding relationship can grow within the context of communication (Satter, 2000). Parents can adopt maladaptive feeding practices when they are concerned about their child's eating behaviors and food intake (Burklow, McGrath, & Kaul, 2002; Kerzner et al., 2015). This can occur when parents attempt to move an infant to a feeding schedule too quickly, thereby ignoring the child's hunger signals so long that feedings become tense. Feeding can also be stressed and anxious when a parent forces an infant to eat, as a parent may when he or she believes the infant is not eating enough or if he or she is using a feeding to encourage the baby to sleep better (Satter, 2000).

The psychological milestones of feeding development greatly depend on caregiver/infant interactions. The psychological milestones that occur between birth to three months, during the period of homeostasis, include cues for feeding (arousal, cry, rooting, sucking), quieting to voice, and caregiver response leading to self-regulation. During this time, interaction with the primary caregiver becomes established with the

infantile smile, and pleasurable feeding experiences lead to greater environmental interaction (Arvedson, 2002). Attachment is increased from three to six months of age. During this period, there is an increase in infant-caregiver interactions, cues for feeding become consistent, parents become the preferred feeders, and the infant calls for attention. From six to 36 months, a child moves toward separation or individualization. He or she copies movements, responds to "no," more actively explores the environment, follows directions, and begins to use speech (Arvedson & Brodsky, 2002). Each of these stages affects child-caregiver interaction and how behaviors around feeding emerge.

Anatomy and Physiology of Feeding and Swallowing

Deglutition, also known as swallowing, is the semiautomatic motor act of the respiratory and gastrointestinal tract muscles, that propels food, mucus, and secretions from the oral cavity to the stomach (Miller, 1986). Swallowing is both nutritive and an act of respiratory protection. Swallowing requires the coordination of the central nervous system, 31 muscles, and over 6 cranial nerves (Bosma, Donner, Tanaka, & Robertson, 1986). The oral cavity is made up of the lips, mandible, maxilla, floor of mouth, cheeks, tongue, hard palate, soft palate, and anterior portions of the tonsillar pillars that must all work in coordination during feeding and swallowing. One of the main muscles involved in swallowing is the tongue, which has both oral and pharyngeal surfaces (Matsuo & Palmer, 2008). During speech and swallow, it can protrude, retrude, twist, and produce multiple 'intrinsic' shapes (Zald & Pardo, 1999).

The anatomy of the head and neck of the newborn up to around 4 months of age is different from that which develops later in infancy and through adulthood. In an infant, the palate is flatter, dentition has not yet erupted, the larynx and hyoid bone are higher in

the neck, and the epiglottis touches the back of the soft palate leaving the larynx open to the nasopharynx (Matsuo, 2008). In early infancy, there is only a relative oral cavity, as the tongue envelopes the area of the mouth, approximating the borders. Issues with feeding may be masked during this time due to the close proximity of oral pharyngeal structures and the predominance of early reflexes (Arvedson, 2002). The lack of a true oropharynx, the tongue being encompassed within borders of the mouth, and the presence of reflexes dominating feeding may lessen the occurrence and/or appearance of feeding problems. As anatomical changes occur, resulting in a true oropharynx and increased space for the tongue to move, and as reflexes integrate, feeding problems may become more apparent. As an infant matures and the neck elongates, the larynx descends to a lower position in the neck, and the epiglottis no longer contacts the soft palate. This change allows the pharynx to act as both an airway and a food way, making an individual more vulnerable to aspiration (Matsuo, 2008). The primary teeth emerge around six months of age and fall out during childhood at various times. Generally, permanent teeth erupt around the ages of six or seven.

The process of swallowing can be sectioned into phases: oral preparatory, oral, pharyngeal, and esophageal. The oral preparatory phase, also known as bolus preparation, is voluntary. Before the infant or child is old enough to self-feed, he or she must be fed by a parent or caregiver (Arvedson, 2002). During infancy, the oral preparatory phase is characterized by latching onto the nipple, liquid entering the mouth and the lips passively assisting with maintaining the liquid intraorally. The liquid bolus is held in the anterior portion of the floor of the mouth or on groove of the tongue surface against the hard palate “("CADTH Rapid Response Reports," 2016). The airway remains open for

respiration until the pharyngeal swallow is triggered (Arvedson, 2002). Once semi-solids and solids are introduced bolus formation becomes more complicated and oral preparatory time increases and changes with the consistency of the food.

The oral phase of swallow is also voluntary. In a normal swallow, the base of tongue seals against palate to hold the bolus in the oral cavity, keeping it from spilling over into the airway before the swallow reflex is triggered during the pharyngeal phase. The oral phase begins as the tongue propels the bolus posteriorly and ends with triggering the pharyngeal swallow. The greatest risk of aspiration occurs during the pharyngeal phase, once the swallow has triggered and respiration ceases (Arvedson, 2002). The tongue elevates, touching both the hard and soft palate as it propels the bolus posteriorly. The soft palate seals against the pharyngeal wall to prevent leakage into the nasopharynx. Tongue base propulsion is important in triggering the pharyngeal swallow (Arvedson, 2002). The pharyngeal wall and base of tongue "squeeze" the bolus down toward the esophagus, and the pressure gradient opens the UES and pushes the bolus through it (Taniguchi, Tsukada, Ootaki, Yamada, & Inoue, 2008). During the esophageal phase, a peristalsis wave carries the bolus down through the lower esophageal sphincter (LES) to the stomach.

Posterior Ankyloglossia

Ankyloglossia can be characterized as anterior (ATT) or posterior tongue tie (PTT). Ankyloglossia is a congenital disorder characterized by an abnormal frenulum. Tongue tie was first defined in literature as "a condition in which the tip of the tongue cannot be protruded beyond the lower incisors because of a short frenulum linguae, often containing scar tissue," (Wallace, 1963). Since then, many have attempted to define

ankyloglossia based on tightness or thickness of frenulum, percentage of the tongue along which the frenulum extends, mobility of the tongue, issues surrounding breastfeeding in neonates, and/or heart-shaped tongue upon protrusion (Segal, Stephenson, Dawes, & Feldman, 2007). The many definitions have left the field with a lack of universal agreement. No standard definition - anatomic or functional – currently exists. This disorder is known to cause issues with feeding, speech, and reduced mobility of the tongue. Neonates are the most easily and often diagnosed due to complications during breastfeeding. It is less common for children, adolescents, and adults to receive a diagnosis (Segal et al., 2007). Anterior tongue tie (ATT) is more commonly diagnosed, visible, and easily managed. Hong et. al. (2010) defined ATT as the presence of a prominent lingual frenulum with or without limited lingual protrusion and tongue tip tethering. Conversely, a PTT is characterized by a tether beneath the lingual mucosa. Upon visual inspection, the frenulum is non-prominent but with the use of a grooved director it may appear abnormally prominent, short, thick, or cord-like. Palpation of the frenulum may reveal tightness. PTT can be missed due to its subtle appearance (Hong et al., 2010). Although PTT may be noticed due to issues with bottle feeding such as milk leaking from the mouth or colic, it is more likely to be noticed during breast feeding. PTT may also be overlooked when assessing young children due to children being wary about opening their mouths or practitioners being concerned about being bitten or having inadequate time to assess. Ankyloglossia can be surgically treated with frenectomy (removal of the frenulum), frenotomy (cutting of the frenulum), and frenuloplasty (tongue tie release with anatomic correction). Currently, many professionals are unaware of PTT and those who are aware may struggle with management because there is no

current standardized protocol for diagnosis or treatment. Postsurgical management can include kinesthetic therapy, craniosacral therapy, stretching, or functional reeducation (Suter & Bornstein, 2009). Nonsurgical management includes use of a lactation consultant or a "wait-and-see" approach.

Infant and Childhood Feeding Problems

The Diagnostic and Statistical Manual of Mental Disorders-5 has placed many childhood feeding disorders under the umbrella term "avoidant/restrictive food intake disorder." This grouping can be separated into three feeding behavior subsects: children eating too little, eating a restricted number of foods, or displaying a fear of eating (American Psychiatric Association, 2013; Arvedson, 2008). Feeding difficulties are not listed in the DSM-5, and are thought to be a relational disorder between the feeder and the child, and therefore the caregiver's feeding style must be taken into consideration when remedying any feeding difficulties (American Psychiatric Association, 2013; Kerzner et al., 2015). Food refusal may be due to an organic cause, such as dysphagia or pain during swallow. Aspiration may be "silent" or can be associated with choking or coughing when any phase of swallow (oral preparatory, oral, pharyngeal, or esophageal) is disorganized or disordered. Behavioral feeding problems can be indicative of organic issues (Kerzner et al., 2015). Gastrointestinal (GI) disorders and respiratory disorders can impact feeding development.

Childhood feeding disorders are considered common, despite varying incidence and prevalence rates (Arvedson & Brodsky, 2002). The issue in determining prevalence is due to the lack of a universal definition for feeding problems. Problems with feeding may result in failure to thrive, delayed growth/development, rigid diet, and difficult

feeding behaviors. Early feeding disorders can result from feeding experiences and may stem from organic causes. Characteristics associated with diagnoses such as Down syndrome and Cerebral Palsy can impact feeding development as can congenital malformations. Congenital malformations result from genetic and environmental factors, causing central nervous system damage, anatomic defects, or airway anomalies (Arvedson & Brodsky, 2002). In infants, when malformation of the lips, tongue, cheeks, maxilla, or mandible are present, sucking and swallowing is potentially compromised (Arvedson & Brodsky, 2002). Tongue malformations like those seen in individuals with ankyloglossia and Down syndrome can interfere with feeding and swallowing (Arvedson & Brodsky, 2002). The low tone associated with Down syndrome can result in oral sensorimotor incoordination (Arvedson & Brodsky, 2002). The shortened frenulum characteristic of ankyloglossia interferes with tongue protrusion and elevation (Arvedson & Brodsky, 2002).

A variety of prenatal, medical, environmental, behavioral, and parental factors contribute to childhood feeding disorders. When left untreated, feeding disorders may result in complications, including aspiration pneumonitis, failure to thrive, and parent-child conflict. Early identification of feeding problems and disorders can result in better nutritional status, growth, feeding safety, and quality of life. Undiagnosed or persistent disorders can impact a child's willingness to explore and can impact his or her feelings of security around eating.

Feeding Assessment Tool

The *Behavioral Pediatric Feeding Assessment Scale* (BPFAS) is a 35 item, parent/caregiver completed assessment scale developed by Crist and Napier-Phillips in

2001. It was originally used to extend knowledge about patterns of behaviors around mealtimes and eating in healthy, normally developing children, and to compare those patterns to two groups of children with feeding difficulties (Crist & Napier, 2001). One of the groups with feeding problems had medical issues related to feeding and the other did not have medical feeding-related issues. Since 2001, it has been used to assess the parental perceptions of mealtime behaviors of children with cystic fibrosis (significantly higher frequency of problem during meals compared to same-age children without CF), premature infants, high-risk infants, and others (Crist et al., 1994; Crist & Napier-Phillips, 2001; Evans, 2012).

While several other assessment tools exist, such as the Montreal Children's Hospital Feeding Scale and the Mealtime Behavior Questionnaire, the BPFAS is best-suited for the current research because it was normed for the age range just past breastfeeding, it measures the frequency of parental and child behaviors, assists in describing the degree to which these behaviors are problematic, and can be used in a survey format, eliminating the need to interview each parent/caregiver. The survey is a time-friendly method to obtain information about the behaviors of both the child and the parent (Marshall, Raatz, Ward, & Dodrill, 2015).The domains assessed in the BPFAS include oral motor or dysphagia, selectivity by food type, selectivity by food texture, and food refusal. The BPFAS has good test-retest reliability and internal consistency (Sanchez, Spittle, Allinson, & Morgan, 2015).

Specific Aims

The field of feeding disorders lacks empirical data about PTT and feeding behaviors beyond the stage of early infancy. Due to the research on PTT and its effects

on breast feeding that demonstrate issues in latching and feeding, and the understanding that the development of childhood feeding is driven by exploration and positive parent-child interaction, research must be undertaken to determine the effects of undiagnosed PTT on feeding in later stages of development. Our aim is to use the BPFAS to better understand whether populations with posterior tongue-tie have more frequently occurring aberrant feeding behaviors than populations without PTT, to assess parental perceptions of which of their child's behaviors and which of their own behaviors are problematic around mealtime, to examine the relationship of age of diagnosis and revision of PTT to the occurrence of behaviors, and to determine how child and parent behaviors influence each other.

Research Hypotheses

The research hypotheses are as follows:

H_1: It is hypothesized that children with PTT will have significantly more aberrant feeding behaviors than typically developing children.

H_{1a} It is hypothesized that children who are diagnosed with PTT at a later age will have significantly more aberrant feeding behaviors.

H_{1b} It is hypothesized that children whose PTT is revised at a later age will have significantly more aberrant feeding behaviors.

H_{1c} It is hypothesized that when a child's diagnosis of PTT is made at a later age, the frequency of negative parental behaviors will increase.

H_{1d} It is hypothesized that when a child's PTT is revised at a later age, negative parental behaviors will increase.

H_{1e} It is hypothesized that when a child's PTT is diagnosed at a later age, the total frequency of aberrant behaviors will increase.

H_{1f} It is hypothesized that when a child's PTT is revised at a later age, the total frequency of aberrant behaviors will increase.

H_2 It is hypothesized that the problem scores for the children with PTT will be significantly higher than those in the normal, healthy feeding group.

H_{2a}. It is hypothesized that children who are diagnosed with PTT at a later age will present with significantly increased total problem scores.

H_{2b}. It is hypothesized that children whose PTT is revised at a later age will present with significantly increased total problem scores.

H_3. It is hypothesized that in this population, when the restiveness of diet index score is increased the poor strategies index score will increase.

Null Hypotheses

H_{01}: It is hypothesized that children with PTT will not have significantly more aberrant feeding behaviors than typically developing children.

H_{01a} It is hypothesized that children who are diagnosed with PTT at a later age will not have significantly more aberrant feeding behaviors.

H_{01b} It is hypothesized that children whose PTT is revised at a later age will not have significantly more aberrant feeding behaviors.

H_{01c} It is hypothesized that when a child's diagnosis of PTT is made at a later age, the frequency of negative parental behaviors will not increase.

H_{01d} It is hypothesized that when a child's PTT is revised at a later age, negative parental behaviors will not increase.

H_{01e} It is hypothesized that when a child's PTT is diagnosed at a later age, the total frequency of aberrant behaviors will not increase.

H_{01f} It is hypothesized that when a child's PTT is revised at a later age, the total frequency of aberrant behaviors will not increase.

H_{02} It is hypothesized that the problem scores for the children with PTT will not be significantly higher than those in the normal, healthy feeding group.

H_{02a}. It is hypothesized that children who are diagnosed with PTT at a later age will not present with significantly increased total problem scores.

H_{02b}. It is hypothesized that children whose PTT is revised at a later age will not present with significantly increased total problem scores.

H_{03}. It is hypothesized that in this population, when the restiveness of diet index score is increased the poor strategies index score will not increase.

CHAPTER 2

METHODS

Participants

This study utilized a convenience sample of parents or caregivers of children with PTT from the United States, New Zealand, Australia, and Canada. Participants were recruited through 9 online support groups. The support groups targeted advocacy for individuals with PTT, served as a community in which individuals and families could share hardships related to the diagnosis, and as a resource to access information. This study targeted participants with children between the ages of 9 months and 7 years, though responses were received from participants with infants as young as 3 days and adolescents as mature as 17 years. A total of 165 parents/caregivers of children with PTT participated in this survey, with only a subsample of $n = 87$ in the target age range. The mean age of the child within the study sample was two years, one month, and 21 days. Older infants and children were targeted to expand research which has previously focused exclusively on breast feeding and to include parental perceptions and use of strategies to address feeding issues.

Data Collection and Instrumentation

Parents and caregivers of children diagnosed with PTT completed the BPFAS, which was re-formatted to be delivered online as a survey via Qualtrics™ platform. The survey was initially posted to the listed groups on May 15h of 2017 and was removed to add additional demographic questions on May 28th of 2017. The original survey had 37

participants, whose responses were not included in analysis and are not represented in the final 165 surveys collected. A revised version of the survey constructed from the BPFAS and 8 demographic questions relating to diagnosis and revision of PTT was posted in the participating groups from May 30th to June 28th of 2017. Data were analyzed only for eligible participants who had children within the target age range of 9 months to seven years (n = 87). Five responses were excluded because the participants included information about more than one child on their survey. All surveys were completed through Qualtrics™ without assistance.

The BPFAS is a caregiver, judgement-based form that includes 35 questions regarding mealtime feeding behaviors, parental feeding strategies, and parental perceptions of their child and their own behaviors (Crist & Napier-Phillips, 2001). It was originally normed based on children ages 9 months to seven years and has been used to measure the feeding behaviors of children with multiple diagnoses since its creation. While it has been validated and used with populations of infants and children with physical and cognitive diagnoses in prior research, this is the first time it has been employed to assess behaviors associated with PTT.

The first 25 questions on the scale ask the participant to rate the frequency of their child's behaviors on a five-point Likert scale (1=never, 3=sometimes, 5=always) and then state whether the behavior is a problem for them (yes/no). Section two consists of 10 questions and asks the participant to rate the frequency of his or her own behavior and/or use of strategies relating to their child's mealtime on the same Likert scale (1=never, 3=sometimes, 5=always). Items are phrased positively and negatively on both sections of the tool. For example, child behaviors such as "enjoys eating" and "whines or cries at

feeding time" are rated by how frequently they occur. Statements about parent behavior include phrases such as "I get frustrated and/or anxious when feeding my child" and "I feel confident my child gets enough to eat" and are also rated based on frequency of occurrence. The participant is then asked to state whether each of the child's behaviors and his/her own are problematic (yes/no). Scores are generated from the Likert scale responses and the number of behaviors identified as problems.

Scores can be calculated on the BPFAS for child frequency of behaviors (CFS) and parent frequency of behaviors (PFS). When norms were established, a total frequency score (TFS) and a total problem score (TPS) were calculated to allow for comparison across the populations studied. The TFS is inclusive of the CFS summed with the PFS and is calculated by adding the scores of maladaptive feeding behaviors to the inverse scores of positively described behaviors. Specifically, items 1, 3, 5, 6, 8, 9, 16, and 18 in the child behavior section and items 29 and 30 in the parent behavior section were reverse scored. Higher scores reflect a greater occurrence of aberrant behaviors related to feeding/mealtime. A TFS of > 84 is considered cause for a referral for nutritional intervention (Crist, 2001). The TPS incorporates the child problem score (CPS) and the parent problem score (PPS). A higher TPS signifies that more child and parent behaviors are endorsed by participants as problematic as they relate to feeding and mealtime.

Two indices provide an opportunity to describe how restricted a child's diet is perceived to be and also how often parents resort to using negative feeding strategies. The restrictiveness of diet index (RDI) is the sum of scores on six items on the child behavior portion of the BPFAS. The test items relate to the frequency that the child: eats fruits, will try new foods, eats meat or fish, drinks milk, eats vegetables, and eats

starches. A higher RDI reflects a narrower or more restricted diet while a lower index score is associated with a more varied diet. The poor strategies index (PSI) is the sum of scores on four of the items on the parent behavior section. Specifically, parental behavior characterized by coaxing, using threats, making multiple meals, and force feeding, make up this index. A higher PSI is associated with more frequent use of negative strategies by parents during mealtime while a lower index score reflects less use.

The responses to the BPFAS were scored to gain information about the frequency of child feeding behaviors, the frequency of parent feeding behaviors, the degree to which the behaviors were problematic, the relationship between index scores, and the association between two independent variables and CFS, PFS, TFS, and TPS scores. Analysis of individual survey items was also performed, and the most frequently endorsed feeding problems identified by parents of children with PTT were informally compared to the behaviors most frequently endorsed as problematic by the parents of the normative group.

Variables

Independent Variables

Independent variables include the sample group of parents and caregivers of infants and children, between the ages of 9 months and 7 years, with a diagnosis of PTT, the normative group, the age at which children with PTT were diagnosed, and the age at which children with PTT had a revision. The variables originated from the inclusion and exclusion criteria and the demographic questions.

Dependent Variables

The survey portion measured the following dependent variables: frequency of

child feeding behaviors, frequency of parental behaviors, the total frequency of behaviors, number of child behaviors classified as problematic by the participant, number of participant behaviors classified as problematic, restrictiveness of diet index score, and the poor strategies index score.

Data Analysis

All completed surveys were exported to Excel (Microsoft, 2016) and numerically coded in preparation for analysis. The data were exported to SPSS Version 24 (Microsoft) for statistical analysis. Descriptive and summary statistics characterized demographics, as well as, the frequency of child and parent behaviors around mealtime, perception of problem behaviors of both child and parent, relationship of age of diagnosis and age of revision to behaviors, and association between restrictive behaviors in children and the use of negative mealtime strategies by parents. Ad hoc analysis of the most frequently reported problematic child behavior by participants was made and informally compared to normative data.

The data were analyzed using parametric and non-parametric statistics. Specifically, a one-sample t- test was conducted to determine if a statistically significant difference in the TFS score and the TPS exists between the PTT group compared to the normative group. Analysis of the sub-hypotheses was performed using Spearman correlation to determine whether there are associations between the independent variables of age at the time of diagnosis and age at the time of revision to the CFS, PFS, TFS, and the TPS. Spearman correlation was also used to determine whether a relationship exists between the RDI and the PSI. Ad hoc analysis of individual survey items was completed, and the most frequently endorsed feeding problems identified by parents of children with

PTT were informally compared to the behaviors most frequently endorsed as problematic by the parents of the normative group.

CHAPTER 3

RESULTS

Descriptive Statistics

Descriptive and summary statistics are comprised of demographics, as well as the total frequency of maladaptive behavior scores and total problem scores in comparison to normative data. In addition, analysis described the association between the age of diagnosis and the age of revision to the CFS, PFS, TFS, and the TPS. The association between the RDI and the poor PSI was also described. A total of 87 participants were included in this study.

Parametric Analysis

Parametric tests were used to compare the means of the sample and normative data sets since both were normally distributed and independent. A one-sample t-test was conducted to determine if a statistically significant difference in scores on the BPFAS existed between the PTT sample ($N = 87$) and a normative sample ($n = 96$; Crist & Napier-Phillips, 2001). The TFS for the PTT group ranged from 52.52 to 96.62 while the normative group ranged from 36.3 to 56.9. Statistically, the PTT group ($M = 74.57$, $SD = 22.05$) had a significantly higher TFS than the normative sample ($M = 63$, $SD = 14.2$), $t(86) = 4.52$, $p < .001$ indicating that maladaptive behaviors by children and parents around feeding occurred more often in the PTT sample. The TPS for the PTT group ranged from -1.27 to 13.43 while the normative group ranged from -1 to 5.4. The PTT group's TPS ($n = 74$, $M = 6.08$, $SD = 7.36$) was significantly higher than normative

group's (M = 3.0, SD = 4.5), $t(73) = 3.60$, $p = .001$) indicating that participants identified more behaviors as problematic for them around mealtime in the PTT sample. A summary of the mean TFS and mean TPS for the PTT group and the normative group is presented in Table 1. T-test statistics for TFS and TPS are summarized in Table 2 and Table 3 respectively.

Non-Parametric Analysis

Spearman correlation was used to explore associations between the age at which a child was diagnosed with PTT and the age at which revision occurred and the CFS and the PFS. Results indicate that there is a statistically significant positive correlation between the CFS and both age of diagnosis ($\rho = .267$, $p = .013$) and age of revision ($\rho = .375$, $p = .001$). Additionally, there is a statistically significant positive correlation between PFS and both age of diagnosis ($\rho = .260$, $p = .016$) and age of revision ($\rho = .359$, $p = .001$. The data suggests that age of diagnosis and age of revision are associated with maladaptive child and parent behaviors with the strongest association between aberrant child behaviors and revision of PTT at a later age. The second strongest relationship was observed between revision of a child's PTT at a later age and the frequency of negative parent behaviors displayed during mealtime. A summary of statistics related to the association between age of diagnosis and age of revision to CFS and PFS is presented in Table 4 and Table 5 respectively.

Spearman correlation was used to examine the associations between the between the age at which a child was diagnosed with PTT and the age at which revision occurred and the TFS and the TPS. Results indicate that there is a statistically significant positive correlation between TFS and both age of diagnosis ($\rho = .271$, $p = .012$) and age of

revision ($\rho = .381$, $p = .001$). A significant positive correlation is also found between TPS and the age of diagnosis ($\rho = .234$, $p = .046$) and age of revision ($\rho = .384$, $p = .001$). The analysis suggests that the later a child is diagnosed and the later the PTT is revised the more frequently maladaptive behaviors are displayed by both children and parents and the more problematic behaviors are perceived. The strongest positive correlation was observed between a child's age at the time of PTT revision and an increase in child and parent behaviors being characterized as problematic by participants. A summary of results is presented in Table 6.

A significant positive association was observed between the RDI and the PSI ($\rho=.445$, $p < .001$). The correlation suggests that when restrictive eating behaviors increase in children then parental use of poor feeding strategies also increases. This relationship was also observed in the normative sample. A summary of statistics related to the relationship between RDI and PSI is presented in Table 7 and a scatter plot of the association is displayed in Figure 1.

Ad Hoc Analysis

Behaviors identified as most often problematic were identified by participants in the PTT sample as well as within the normative group. The percentage of participants who endorsed the behaviors as problems was documented and informally compared for both groups. The PTT sample was smaller than the normative group but the percentage of PTT participants citing behaviors as problems at mealtime was larger for each item. A summary of the comparison is presented in Table 8.

CHAPTER 4

DISCUSSION

Posterior tongue-tie (PTT) is a congenital disorder characterized by a submucosal lingual tether that can decrease tongue mobility and that can impact speech and feeding. No definition of PTT is universally accepted, and little to no research around feeding beyond early infancy exists. Due to the subtle appearance of PTT, it is more likely to be missed if not diagnosed in relation to breastfeeding (Hong et al., 2010). Professionals are less likely to assess for PTT due to lack of knowledge about the anomaly, inadequate information about how to assess, and concern about being bitten by a resistant child. Even when diagnosed, revision of PTT is performed based on the specific practitioner's training and experience. A standardized procedure for surgical management or pre-and post-care has not been accepted. The purpose of this study is to use the *Behavioral Pediatric Feeding Assessment Scale* (BPFAS) to determine whether children with PTT have more frequently occurring problem feeding behaviors and to determine the degree to which those behaviors are considered problematic by caregivers when compared to the normal, healthy feeding group. In addition, the research also seeks to examine the relationship between age of diagnosis and revision to problem feeding behaviors and to describe the relationship between child and parent behaviors. Our findings support that there is an increased frequency of aberrant child and parent feeding behaviors and that those behaviors are perceived as resulting in more problems in in the PTT sample than

when compared to norms. In addition, our results support the hypotheses that the later the age of diagnosis and revision the more frequently negative behaviors occur and the more often they are identified as problematic. A positive relationship between restricted child intake and an increase in the use of poor strategies by parents was also observed.

Total frequency scores and total problem scores were significantly higher in our PTT cohort when compared to the normal, healthy feeding group. Total frequency scores are the sum of negative child behaviors and parent behaviors. Total problem scores are the totality of child and parent behaviors identified as being problems around mealtime. It is not surprising that children with PTT and their parents present with a greater number of maladaptive behaviors and that these behaviors are perceived as problematic in relation to the development of positive feeding. Feeding development is based on exploration of food and liquid, socialization, and positive parent/child interaction in a safe environment. Children with PTT who may experience significant delays in being diagnosed and treated, may be offered food and liquid that is difficult for them to manage due to decreased lingual range of motion. Parents, intent on providing adequate nutrition, may become anxious and push their children to eat and drink items that are either unpleasant, unmanageable, and/or unsafe. Repeated negative experiences by both children and parents only serve to increase tension and the frequency of undesirable behaviors overall.

Though this study is the first to examine feeding behaviors of older infants and children with PTT and their parents, oral intake of nutrition and the practices supporting the action have been examined in other populations in which diagnosis and management may occur at a later age. Mehta (2018), used the BPFAS to examine feeding behaviors of

children and their parents in cohorts diagnosed with eosinophilic esophagitis (EoE) and/or gastro esophageal reflux disease (GERD). Higher total frequency scores and total problem scores were observed in these populations when compared to normative data as well. In addition, specific behaviors included in the child and parent portions of the scale were identified as most problematic in both our PTT cohort and the EoE and GERD groups. These behaviors include taking >20 minutes to finish a meal and preferring to drink rather than eat.

Food allergies, which are often diagnosed and/or managed at a later age, have also been associated with negative feeding behavior in children. A retrospective chart review of 302 children referred to a multidisciplinary feeding program revealed that a higher proportion of individuals had co-occurring food allergies compared to the general population (Yeung et al., 2015). Gastrointestinal, oropharyngeal and growth symptoms associated with food allergy (Canani, Ruotolo, Discepolo, & Troncone, 2008) can disrupt either the acquisition of feeding skill and/or the motivation of a child to explore and eat food (A. Haas, 2010). In fact, so close is the association between food reaction and negative feeding behavior that atypical nutritional intake can serve as the initial symptom that leads to diagnosis of a food allergy (A. M. Haas & Maune, 2009). The motivation to explore and consume food, particularly as children are expected to progress in the management of viscosity and texture, can be negatively influenced by an oral anomaly such as PTT that is difficult to recognize and manage and that reduces lingual range of motion. The significance of negative child and parent feeding behaviors in the PTT sample suggests that atypical nutritional intake may be also serve as an early sign that leads to diagnosis of the submucosal tether. As more studies are conducted to examine

feeding behaviors in the PTT population, problems with oral intake may be confirmed as an accepted cause for referral for a lingual assessment.

Recognition of the influence of late diagnosis and management of a problem such as PTT has on feeding behaviors, and awareness of the benefit of early identification and care is supported in the literature relating to children with esophageal atresia (EA). The problems associated with feeding in this population were first described by Puntis, Ritson, Holden, & Buick (Puntis, Ritson, Holden, & Buick, 1990) as choking, coughing, lengthy mealtimes, and food refusal. Early multidisciplinary care with specific attention to a child's oral intake has been shown to improve feeding outcomes (Menzies, Hughes, Leach, Belessis, & Krishnan, 2017). Further, professionals such as speech-language pathologists (Menzies et al., 2017) occupational therapists, dieticians, and psychologists have been recommended to be included on care teams to assist children and their families with feeding-related problems (Ramsay & Birnbaum, 2013). As our results support that aberrant behaviors around feeding increase when diagnosis and/or management of PTT is delayed, we can infer that earlier appropriate care can improve outcomes.

Some of the most frequently occurring behaviors cited as problems by participants in the PTT sample included 'making multiple meals" and that their child frequently "gets up from the table during meals, "does not try new foods", and "tantrums at mealtime. Though participants were not asked specifically about their level of stress we can infer that both child and parent problem behaviors such as the ones identified as problematic place a strain on the family. Restrictive, self-limiting, and/or negative child feeding behaviors are also observed in infants, toddlers, and children with cystic fibrosis (Berge et al., 2017; Chatoor, 2009; Driscoll et al., 2015; Mehta et al., 2018; Rogers,

Ramsay, & Blissett, 2018). In a study by Driscoll and colleagues (Driscoll et al., 2015), children with cystic fibrosis demonstrated a higher frequency of textured food refusal, general food refusal, stalling, and picky eating compared to normal, healthy feeding peers. In addition, a positive correlation between the restrictive eating/texture refusal in children and parental stress was observed in the same sample. This relationship was also observed in our PTT sample as evidenced by the correlation between the restricted child intake index scores and an increase in the poor strategies index scores by parents.

In general, the combination of self-limiting behaviors and use of aggressive feeding strategies can result in further mealtime problems. When underlying medical conditions are either undiagnosed, ineffectively treated, or medical management necessitates limitation of diet or hampers natural mealtime experiences then problem feeding behaviors may occur in a higher frequency (Chatoor, 2009; Mehta et al., 2018). Parents stressed about their child's nutritional intake have been shown to be more likely to use pressure-to-eat feeding practices (Berge et al., 2017) and to use less encouraging language when describing their child's diet (Rogers et al., 2018). Use of negative mealtime strategies by parents has been associated with children demonstrating more self-limiting behaviors during oral intake. In addition, restrictive oral intake has been show to increase parental stress which creates a negative feeding cycle (Scaglioni, Salvioni, & Galimberti, 2008). PTT is poorly understood, inadequately researched, lacks agreement regarding diagnosis and management which all potentially result in late identification, late treatment, inefficient management, and/or a complete absence of care. Our results support that children with PTT present with increased self-limiting feeding

behaviors and parents use more negative strategies during mealtimes which place this population at greater risk for a dysfunctional feeding cycle to occur.

Our study had several limitations, including the lack of universally accepted criteria for the diagnosis of PTT which means that some of the participant's children may have been incorrectly diagnosed with the anomaly. In addition, the confusion and disagreement around the oral tether by professionals and lay persons alike may have contributed to this problem. Disagreement about the revision process of a PTT is also problematic as children in our study with the lingual tether may have been ineffectively treated which could have influenced their feeding behaviors as well. Ultimately, we relied on parent report that their child was correctly diagnosed with PTT and/or effectively treated. Another limitation is that we only had online access to participants so if questions arose while completing the survey the individuals may have chosen to interpret items independently rather than contacting us for clarification. Future studies could address these limitations by including subjects who were diagnosed by a professional or consortium of professionals with optimal knowledge of recognizing and diagnosing PTT, obtaining a 72-hour food log for each child to be able to consider actual intake in relation to report of behaviors, conducting face-to-face parent interviews and performing comprehensive on site feeding evaluations. Further research could also focus on developing a screening tool, using feeding behaviors as a portion of the diagnostic criteria, in addition to inclusion of specific measurements of pre-and post-lingual range of motion to identify individuals with PTT.

In conclusion, the overarching intent of this study is to add to the knowledge base relating to individuals with PTT. Our efforts were focused on collection of demographic

data in addition to identifying feeding behaviors exhibited by children and parents within the population. Our findings are consistent with research on other diagnoses and their effects on feeding. For this sample and this context, the BPFAS proved beneficial in comparing the PTT population to norms. Our data support that when children present with negative or restrictive feeding behaviors, parent behavior is impacted as well. Our study highlights the importance of early diagnosis, wherein professionals must be aware of PTT and consider the diagnosis when a child demonstrates a feeding problem. Further, universally accepted procedures must be adopted to properly diagnose and manage PTT so that future problems and limitations can be avoided.

Table 1. Total Frequency Score Means/Total Problem Score Means-PTT OTs, dietitians, and psychologists

	n	*Mean*	*SD*
PTT Group Total Frequency Score	86	74.75	22.0
Norms – Total Frequency Score	96	46.6	10.3
PTT Group Total Problem Score	74	6.08	7.35
Norms – Total Problem Score	96	2.2	3.2

Table 2. One-Sample t-test - Total Frequency Score-PTT compared to Normative Data

			Test Value = 63.9			
	t	*df*	Sig. (2-tailed)	Mean Difference	95 % Confidence Interval of the Difference	
					Lower	Upper
Total Frequency Score	4.515	86	<.001	10.6747	5.974	15.3746

Table 3. One-Sample t-test - Total Problem Score – PTT compared to Normative Data

			Test Value = 3.0			
	t	*df*	Sig. (2-tailed)	Mean Difference	95 % Confidence Interval of the Difference	
					Lower	Upper
Total Problem Score	3.602	73	.001	3.081	1.3761	4.7861

Table 4. Correlation between Age of Diagnosis/Age of Revision and Child Frequency Score

		Child Frequency Score
Age of Diagnosis	Correlation Coefficient	.267*
	Sig. (2-tailed)	.013
	n	86
Age of Revision	Correlation Coefficient	.375**
	Sig. (2-tailed)	.001
	n	78

Note. *Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 5. Correlation between Age of Diagnosis/Age of Revision and Parent Frequency Score

		Parent Frequency Score
Age of Diagnosis	Correlation Coefficient	.260*
	Sig. (2-tailed)	.016
	n	86
Age of Revision	Correlation Coefficient	.359**
	Sig. (2-tailed)	.001
	n	78

Note. *Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 6. Correlation between Age of Diagnosis/Age of Revision and Total Frequency Score/Total Problem Score

		Total Frequency Score	Total Problem Score
Age of Diagnosis	Correlation Coefficient	.271*	.234*
	Sig. (2-tailed)	.012	.046
	n	86	73
Age of Revision	Correlation Coefficient	.381**	.384**
	Sig. (2-tailed)	.001	.001
	n	78	66

Note. *Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 7. Correlation between Restrictive Diet Index and Poor Strategies Index

		Restrictiveness of Diet	Poor Strategies
Restrictive Diet	Correlation Coefficient	1.000	.445**
	Sig. (2-tailed)	.	.000
	n	87	87
Poor Strategies	Correlation Coefficient	.445**	1.000
	Sig. (2-tailed)	<.001	.
	n	87	87

Note. ** Correlation is significant at the 0.01 level (2-tailed)

Table 8. Most Frequently Endorsed Problem Behaviors – Comparison PTT/Norms

Behaviors identified as problematic most often	Percentage (PTT)	*n* =	Percentage (Norms)	*n* =
Gets up from the table during meal	37.9	58	20.8	96
Refuses to eat meals but requests food immediately after the meal	30.5	59	18.8	96
Whines or cries at feeding time	25.9	58	14.6	96
Eats junky snack foods, but will not eat at mealtime	28.8	59	18.8	96
Tantrums at mealtime	29.3	58	12.5	96
Will not try new foods	32.3	59	11.5	96

Table 9. Summary of Tested Hypotheses

Hypothesis	Statement	Results
H_1	It is hypothesized that children with PTT will have significantly more aberrant feeding behaviors than typically developing children.	Supported
H_{1a}	It is hypothesized that children who are diagnosed with PTT at a later age will have significantly more aberrant feeding behaviors than typically developing children.	Supported
H_{1b}	It is hypothesized that children whose PTT is revised at a later age will have significantly more aberrant feeding behaviors.	Supported

H_{1c}	It is hypothesized that when a child's diagnosis of PTT is made at a later age, the frequency of negative parental behaviors will increase.	Supported
H_{1d}	It is hypothesized that when a child's PTT is revised at a later age, negative parental behaviors will increase.	Supported
H_{1e}	It is hypothesized that when a child's PTT is diagnosed at a later age, the total frequency of aberrant behaviors will increase	Supported
H_{1f}	It is hypothesized that when a child's PTT is revised at a later age, the total frequency of aberrant behaviors will increase.	Supported
H_2	It is hypothesized that the problem scores for the children with PTT will be significantly higher than those in the normal, healthy feeding group.	Supported
H_{2a}	It is hypothesized that children who are diagnosed with PTT at a later age will present with significantly increased total problem scores.	Supported
H_{2b}	It is hypothesized that children whose PTT is revised at a later age will present with significantly increased total problem scores.	Supported
H_3	It is hypothesized that in this population when the restrictiveness of diet index score is increased the poor index strategies score will increase.	Supported

Table 10. Summary of Tested Null Hypotheses

Hypothesis	Statement	Results
$\mathbf{H_{01}}$	It is hypothesized that children with PTT will not have significantly more aberrant feeding behaviors than typically developing children.	Reject
$\mathbf{H_{01a}}$	It is hypothesized that children who are diagnosed with PTT at a later age will not have significantly more aberrant feeding behaviors.	Reject
$\mathbf{H_{01b}}$	It is hypothesized that children whose PTT is revised at a later age will not have significantly more aberrant feeding behaviors.	Reject
$\mathbf{H_{01c}}$	It is hypothesized that when a child's diagnosis of PTT is made at a later age, the frequency of negative parental behaviors will not increase.	Reject
$\mathbf{H_{01d}}$	It is hypothesized that when a child's PTT is revised at a later age, negative parental behaviors will not increase.	Reject
$\mathbf{H_{01e}}$	It is hypothesized that when a child's PTT is diagnosed at a later age, the total frequency of aberrant behaviors will not increase.	Reject
$\mathbf{H_{01f}}$	It is hypothesized that when a child's PTT is revised at a later age, the total frequency of aberrant behaviors will not increase.	Reject
$\mathbf{H_{02}}$	It is hypothesized that the problem scores for the children with PTT will not be significantly higher than those in the normal, healthy feeding group.	Reject

H_{02a}	It is hypothesized that children who are diagnosed with PTT at a later age will not present with significantly increased total problem scores.	Reject
H_{02b}	It is hypothesized that children whose PTT is revised at a later age will not present with significantly increased total problem scores.	Reject
H_{03}	It is hypothesized that in this population, when the restiveness of diet index score is increased the poor strategies index score will not increase	Reject

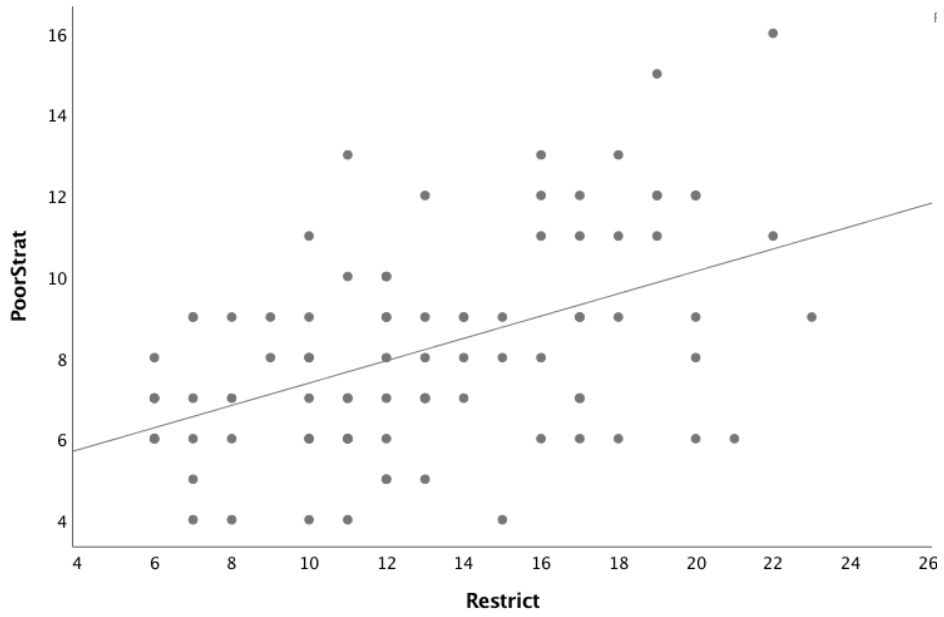

Figure 1. Scatterplot – Association of Restrictive Diet to Poor Strategies

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APPENDIX: ABBREVIATIONS

ATT	Anterior Tongue Tie
BPFAS	*Behavioral Pediatric Feeding Assessment Scale*
CF	Cystic Fibrosis
CFS	Child Frequency Score
EA	Esophageal Atresia
EoE	Esonophillic
GERD	Gastroesophageal reflux disease
GI	Gastrointestinal
PFS	Parent Frequency Score
PSI	Poor Strategies Index
PTT	Posterior Tongue Tie
TFS	Total Frequency Score
TPS	Total Problem Score
RTI	Restrictiveness of Diet Index
UES	Upper esophageal sphincter

CURRICULUM VITAE

McKenzie Sexton
Louisville, KY 40206
(502)716-1051
mckenzieesexton@gmail.com

EDUCATION:

B.A. in Psychology (Cum Laude)
University of Louisville
Louisville, KY
20012-2016

M.S. in Speech-Language Pathology
University of Louisville
Louisville, KY
Expected Graduation May 2018

OTHER POSITIONS AND EMPLOYMENT:

Community Living Support
Centerstone, Louisville, KY.
March 2012- Present

Karate Instructor
Olympic Karate Studio, Louisville, KY.
January 2006- July 2012

PROFESSIONAL MEMBERSHIPS AND ACTIVITIES:

Member of National Student Speech-Language-Hearing Association (NSSLHA)
2016- present

Member of American Speech-Language-Hearing Association (ASHA)
2016- present

Lead (Volunteer) for Resilient Families Project
2013-2016

CLINICAL ACTIVITIES: ***The Chatter Box, Private Practice Practicum Site***, Louisville, KY
June- August 2017

Norton Neurscience and Spine Rehab, Adult Outpatient Services Practicum Site, Louisville, KY
August- December 2017

TheraPLACE, Pediatric Private Practice Practicum Site, Louisville, KY
May 2017- August 2017

Fairdale Elementary School, ***Mini-Practicum Site***, Louisville KY
October- December 2016

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