

Critical Review: The swallowing function and feeding behaviours of the non-organic failure to thrive pediatric population

Huff, L. K.

M.Cl.Sc.(SLP) Candidate

School of Communication Sciences and Disorders, U.W.O.

"It is amazing how much crisper the general experience of life becomes when your body is given a chance to develop a little strength." (Duff, 2005)

Introduction

Pediatric undernutrition is a clinical syndrome well recognized as a precursor to an array of health problems in the pediatric population (Kessler & Dawson, 1999). Undernutrition may result from insufficient access to calories, or it may be due to the infant's inability to ingest adequate nutrition (Reilly et al., 1999). The latter is typically classified under the umbrella label of 'failure to thrive' (FTT). The diagnostic criteria for FTT in infancy and early childhood are continuously evolving as the medical community establishes accepted definitions and signs of this syndrome (Kessler & Dawson, 1999). Currently, diagnosis is based on the presence of 'wasting', a term used to describe a sudden deficit in weight-for-age or weight-for-height measurements, as compared to norm-based growth charts, and its correlation with weight measurements below the 5th percentile (Boswinkel & Mamula, 2003). The diagnosis of FTT is also closely tied to its known etiology; historically, the most-accepted etiological categories are organic versus non-organic failure to thrive (Kessler & Dawson, 1999). For some infants, there is a known organic cause of their FTT (e.g.; genetic or congenital abnormalities, endocrine deficiencies, disease). However, for others, there is no one characteristic or medical sign concentrated enough as to be considered the root cause of the syndrome (Kessler & Dawson, 1999; Reilly et al., 1999). There has been a strong debate surrounding this dichotomy for many years; some professionals feel that most cases of non-organic failure to thrive (NOFTT) have a neurodevelopmental etiology that is too minute to detect with standard testing, and therefore the term 'non-organic' is inappropriate (Reilly et al., 1999; Ramsay et al., 1993). This aspect of NOFTT is of significant clinical importance to the field of speech-language pathology, as the methodology in assessing and treating any swallowing or feeding dysfunction in this pediatric population will be greatly influenced by the root etiology of the syndrome (Reilly et al., 1999; Mathisen et al., 1989; Kessler & Dawson, 1999).

According to Kessler and Dawson (1999), the mouth plays a role of great importance in growth, development and the general well-being of a child. Furthermore, a child's ability to take in adequate nutrition requires normal anatomy, well-coordinated muscle use, sensory processing abilities, and an encouraging environment (Kessler & Dawson, 1999). When a speech-language pathologist is working with the NOFTT pediatric population, it is of paramount importance to have complete and accurate knowledge of the child's swallowing function and feeding behaviours in order to provide thorough clinical services.

Objectives

The objective of this paper is to critically evaluate existing literature regarding the swallowing function and feeding behaviours of the NOFTT pediatric population in order to provide evidence-based information to guide appropriate treatment options for speech-language pathologists.

Methods

Search Strategy

Computerized databases, including PUBMED, MEDLINE Ovid, and CINAHL were searched using the following search strategy: ((non-organic failure to thrive) AND (swallowing disorders) OR (feeding behaviours) AND (infant))

The literature search was limited to articles written after 1985. One article was accessed through the reference list of a previously searched article.

Selection Criteria

All studies selected for this critical review paper were required to examine impaired swallowing function or feeding behaviours related to the presence of FTT or NOFTT, excluding any concomitant disorders or syndromes.

Data Collection

The resulting literature included the following types of articles: case-control study (2), cohort study (2), survey study (2), case series report (1).

Results

Study #1 - Parkinson, Wright and Drewett (2004) conducted an observational study in order to evaluate energy intake and the feeding behaviours in children who fail to thrive. The authors reported that the case infants had significantly lower energy intake during the meals, however there were no significant differences in the feeding behaviours of the case and control infants. The authors employed a population-based case-control design, sampling their subjects from the Millennium Baby Study carried out in Gateshead England in 1999 and 2000.

Subject Selection - Selecting the subjects from a population-based sample allowed the authors to protect against referral bias, a common issue in NOFTT studies. The methodology for selecting case infants appeared to be somewhat unreliable for the researchers, as 8 of the original case subjects were subsequently excluded following the home visit, at which time it was discovered the infants no longer fulfilled the inclusion criteria. Undependable subject selection methods can lead to inappropriate categorization of the infants, thereby rendering any evidence regarding the case infants inapplicable to the NOFTT population.

Measurement/Procedures - The infants were observed and video-recorded during two lunch-time meals in their home environment; one meal was finger-food based, while the other was all spoon-fed foods. The researchers randomized the order of presentation of the meals in order to control for performance bias. A previously-established feeding behaviour coding inventory was used by the researchers to code both infant and parental feeding acts, and electronic scales were used to weigh the infant and the food pre- and post-mealtime. The coding inventory was reported to have inter-observer reliability. Despite this, the coding was performed in real time during the home visit, making it susceptible to errors of inaccuracy. For meal-time, the researchers encouraged the mothers to use a highchair in order to "facilitate the recording process" (p.1031), however it is not clear whether this was standard practice for all infants and may have influenced their feeding behaviours. Conversely, researchers did not know which infants were categorized as NOFTT, which allowed for control of coding bias. The behavioural data was found to be skewed, and therefore the non-parametric Mann-Whitney U and Chi-Squared tests were used for analysis. Parametric methods were used for the remaining variables: energy intake, weight of food eaten over meal, and duration of meal, all of which were normally distributed. Overall, this study followed appropriate design and statistical

procedures, albeit with minor procedural drawbacks. The lack of any referral bias and the reasonably large sample size assist in rendering the study's evidence as suggestive, although requiring further investigation.

Study #2 - Ramsay, Gisel, McCusker, Bellavance and Platt (2002) published a prospective cohort study to examine infants and establish if the efficiency of sucking habits was associated with slow weight gain, NOFTT, later feeding behaviours or a change in maternal feeding practices. The authors reported finding that feeding difficulties at 10 months was predictive of later weights in infants. This study had a clear focus and utilized an appropriate design to examine the proposed question.

Subject Selection - The researchers reported a lengthy recruitment period (18 months), an aspect that would typically weaken a study's strength, however it allowed them to acquire a large sample size (207 indexes and 202 controls) while exercising comprehensive inclusion criteria to ensure all subjects were healthy at time of birth.

Measurement/Procedures - The authors selected the Whitney Strain gage to measure efficiency of sucking at one week and 2 months of age, a tool that has previously reported validity. The authors also created a semi-structured interview-based feeding questionnaire that was administered to the mothers during each of five follow-up visits. The questions were reported to be indirectly worded, as not to lead the mothers' responses; as well, the authors established inter-rater reliability for the first two questionnaires delivered. However, the significant results found from this study draw from information received during the later follow-up visits, for which the questionnaires did not have established reliability. This fact, combined with the general subjectivity of the semi-structured interview methodology, act as noteworthy weaknesses of this study. The Hawthorne effect may have also taken place; due to the fact that the researcher was present and coding all feeding behaviours while the mother was feeding their infant, the results may not be representative of the mothers' typical feeding practices. The study's strengths result from the use of random selection of control infants, researcher-blinding during all home visits, and the exclusion of any infants recorded to be 'borderline' in their sucking efficiency on the first home visit. From a statistical standpoint, this study employed complex methods, which at times appeared unnecessary. The authors also adjusted their statistical model for 12 possible moderators without appropriate explanation. This resulted in what seemed to be a 'fishing expedition' and reduced the overall impact of the results. In general, this study delivered equivocal

findings due to its many procedural and analytical weaknesses.

Study #3 - In a 2006 study, Wright, Parkinson, and Drewett explored possible correlations between feeding behaviours and later weight faltering in a population-based prospective cohort study. The authors reported selected avoidant feeding habits in the majority of the children by 12 months, though it had no relationship to later weight faltering once the model was adjusted for appetite. Although this is an appropriate study design for the authors' research goals, this study does not have a clearly focused issue, and as a result, the authors did not have a concrete conceptual model on which to base their model. Consequently, the researchers resorted to "data fishing" during their statistical analysis whereby they tested the significance of numerous variables within the models and progressively removed all non-significant variables. This form of exploratory research is somewhat accepted when the study issue is relatively unfamiliar to the clinical community, however it is a very weak method of studying a phenomenon, and ultimately contributes little to the development of a theory about the phenomenon.

Subject Selection - The sampling methodology of this study was similar to that used by Parkinson et al. (2004), utilizing the Millennium Baby Study in 1999 and 2000. This proved to be an appropriate means of recruiting participants, resulting in a total sample size of 923 infants.

Measurement/Procedures - The procedure for data collection involved a feeding questionnaire designed by the researchers that was sent out to all participants at 6 weeks, 4, 8, and 12 months. Despite the large initial sample size, the return rate of the questionnaires dropped significantly with each round, leaving the researchers with only 63% (578) returned at the 12 month final follow-up. During the development of the questionnaire, the researchers made use of multi-item scales in order to ensure they were targeting the same concept with certain questions, a method which is typically favoured to add validity to perceptual indicators. Additionally, the researchers calculated Cronbach alpha scores to formally test the internal consistency of the items. However, the authors neglected to report all the alpha scores and the scores that were reported (ranging from 0.75 to 0.3) can not be considered strong according to the commonly accepted threshold of 0.7 (Portney & Watkins, 2000). Furthermore, the questionnaire item related to 'child's appetite' was a single-item measure, thereby reducing its validity. Despite this, the authors claim strong conclusions regarding their findings of 'child's appetite'. This study's measurement tool was primarily rooted in the

mothers' perceptions, and as such, it is vital that the researchers ensure they have a strong measurement model prior to testing. A pre-test of the feeding questionnaire instrument would have assisted in improving the overall strength of the tool, thus rendering the study more clinically valid. Despite the stated findings, this study's measurement questionnaire displayed serious internal flaws, thereby resulting in questionable equivocal evidence.

Study #4 - In 1999, Reilly, Skuse, Wolke, and Stevenson completed a study exploring the presence of oral-motor dysfunction (OMD) in the NOFTT population. They also hypothesized about potential neurodevelopmental abnormalities when OMD is present in a NOFTT infant, as well as the causes of NOFTT in infants who do not present with any OMD. The authors were able to report that a significant proportion of the NOFTT children in their sample displayed OMD, however they were not able to account for this with any neurodevelopmental findings. Appropriately, a prospective longitudinal survey was devised in order to collect and analyze pertinent information about the population in question.

Subject Selection - The subjects were all born within one calendar year, and were recruited from participating child-health clinics within an inner city region. As such, the population was very homogenous with regards to socio-economic status (SES), a factor that may have influenced the outcome of the study. The authors were able to recruit a large sample, 1554 infants in total including 47 cases of NOFTT, while enforcing stringent exclusion criteria to ensure all cases of FTT did not have an organic etiology.

Measurement/Procedures - The information was collected through numerous methods: retrospective review of Hospital health records, a semi-structured interview with the primary caregiver regarding the infant's history, behaviours, and caregiving practices, and a video-recorded meal in the home environment. The researchers made use of the screening version of the Schedule for Oral Motor Assessment (SOMA), a measurement tool they report to be previously proven reliable and valid. The researchers rated the feeding practices of the infant retrospectively from the video recording, thereby allowing themselves ample time to score the SOMA accurately. However, there was no indication that the researchers were blinded to the infant's health status at the time of rating. The authors also neglected to report any validity or reliability scores for the interview questions they used, nor did they provide any example questions. Such an oversight leaves the outcome of this study questionable, regardless of the use of appropriate non-parametric and parametric

methods. The specific feeding details derived from the SOMA results are very valuable to clinicians working with NOFTT infants. Nevertheless, the lack of validity for the interview questions and the use of a revised hypothesis at the end of the study render the evidence dubious.

Study #5 - In a study completed by Ramsay, Gisel, and Boutry (1993), the authors examined the similarities in the feeding behaviours of NOFTT and FTT infants. The results involved the discovery that feeding issues may manifest prior to the onset of NOFTT; NOFTT infants have an abnormal length of feeding time, a decreased appetite, a lower tolerance for food textures and deviant feeding habits. The authors reported these feeding issues as being very similar to those seen in the organic FTT infants, and point to a possible common cause for the two categories of undernutrition.

Subject Selection - The prospective longitudinal survey recruited 60 infants, evenly distributed for sex, from a FTT and Feeding Disorders Clinic over three years. The subjects were all referred to the clinic for potential energy intake issues by either their pediatrician or a caregiver who felt anxious regarding the infants feeding habits. Despite the strong potential for referral bias, this method of recruitment is suitable because all infants in this study were intended to have a form of FTT. The researchers classified the infants into either an organic FTT or NOFTT category following pediatrician opinion on the current health status of the infant. This form of categorization is highly subjective, as the pediatricians were not using a standardized tool to assess the infants' health, and it acts as a weakness of this study.

Measurement/Procedures - The procedure of the study involved an appointment at the referring clinic with a team of clinical professionals. The parents provided a three-day food diary, participated in a semi-structured interview regarding the health history and feeding habits of their child, as well as an observed meal with the infant. The researchers were able to observe the meal through a two-way mirror, a strength of the study as this would have controlled for the Hawthorne effect taking place, allowing the parents to engage in a typical meal with the child. However, the researchers did not utilize any standardized form of assessment for the oral-motor function of the infant during the meal, instead they relied on perceptual observations of overt oral-facial movements. Although these findings were only used to confirm parent-report of feeding difficulties, there were no statistical strides taken to ensure the findings were consistent. The authors did report numerous examples of the direct and indirect interview questions given, and although it was not reported, the

questions did appear to reflect multi-item scale questions, thereby strengthening their validity. The authors were able to report numerous significant findings, all of which are highly relevant to clinical practice. Overall, this study explores a clinically-relevant issue, while employing appropriate statistical and procedural methods to gain evidence in support of their hypotheses. The few weaknesses of the measurement tools are not sufficient to tarnish the quality of evidence, therefore making this study suitable to inform clinical practice.

Study #6 - Tolia (1995) reported a case series of seven infants presenting with NOFTT, exhaustively detailing their swallowing and feeding behaviours. The author was able to draw parallels and specify aberrant feeding behaviours in five of the seven participants, including decreased appetite, poor sucking ability, refusal to eat, and periodic vomiting when force fed.

Measurement/Procedures - Although a case report is not regarded as strong scientific evidence (Portney & Watkins, 2000), it has the ability to inform clinicians on the subject of an exclusive issue (Greenhalgh, 1997). This case series presents minor weaknesses, including a lengthy follow-up period and a wide age-range of participants. The follow-up period varied across subjects from 21 to 60 months, a fact that could have noteworthy influence on the outcome of each infant. As well, the 17 month age difference in the seven participants does not allow the author to draw inclusive outcomes from the case reports. Despite this, Tolia (1995) reported extensive retrospective data on all seven infants, providing the reader with comprehensive and telling background information. Tolia (1995) also was able to report barium contrast swallowing study results for all seven infants, a test measure lacking in all other pertinent literature. Due to the nature of the data, the information should only act as clinical-validation for previously-held knowledge, albeit informing in its own right.

Study #7 - The final study reviewed for this paper, completed by Mathisen, Skuse, Wolke, and Reilly (1989), utilized a case-control design to develop a clinically-relevant Feeding Assessment Schedule (FAS) for OMD in any non-organic disordered infant population. They also aimed to use the FAS to examine the presence of OMD in a NOFTT sample. The authors reported finding significant differences in the oral-motor ability of NOFTT infants and their control matches, particularly when dealing with pureed textures. Additionally, the authors draw similar conclusions as Ramsay et. al (1993), suggesting that the NOFTT infants displayed some level of neurological

dysfunction, and therefore a label of ‘non-organic’ is misleading.

Subject Selection - All subjects were referred by a ‘health visitor’ from child-health clinics within a defined low SES inner-city area, and were previously known to have a form of FTT. This method of sampling presents two weaknesses: the referral source (i.e.: health visitor) was not defined, nor was their clinical expertise reported, as well as the homogeneity of the sample which renders the results less transferable to the general population. The study also had a relatively small sample size ($n=9$), however the authors were able to match their controls based on a number of relevant variables, therefore increasing the power of their results by controlling for moderators.

Measurement/Procedures - The procedure involved a semi-structured interview with the mother, a video-recorded meal in the home during which the researcher was inconspicuously present, and the presentation of the FAS following the meal. The authors reported the stringent criteria under which they devised their FAS, including a standardized presentation of the varied food categories (liquids, purees, semi-solids, firm-solids). They also developed different versions of the scale for infants 9-12 months and 13-15 months in order to control for the natural development of oral-motor control. While data was not provided, the authors presented a thorough explanation of the conceptual basis of the tool. The scoring of the FAS was done primarily from video, however the researcher recorded specific moments of OMD that he/she felt would not be visible on the videotape. This likely strengthened their ability to detect minute aspects of OMD. Moreover, the researchers were blinded to the subject’s group (case vs. control), thereby reducing the potential for expectation bias. In general, this study provides compelling evidence with regard to the specific feeding difficulties of NOFTT infants, albeit from a homogeneous small sample size.

Conclusions

The reviewed research highlights a number of critical factors when considering the feeding and swallowing capabilities of infants with NOFTT. There are, however, numerous limitations in the research methodology that must be considered if implementing the results in a clinical capacity. Foremost, the recurrent issue of a non-reliable assessment tool when studying the feeding and swallowing habits of infants with NOFTT presents as a major global weakness of these studies. Additionally, the various forms of bias that were potentially present in the studies contribute to a lower

quality of evidence for clinical application. Despite the drawbacks, the following details were extracted from the studies that proved to uphold a high standard of research methodology.

1. Children with NOFTT consumed less energy over the course of a meal and were found to have lower appetites compared to normal infants.
2. Children with NOFTT required longer feeding times compared to normal infants.
3. Children with NOFTT displayed feeding and swallowing habits characteristic of oral-motor dysfunction; pureed textures presented the greatest difficulty for the infants. As well, many of the children with NOFTT were reported to be hypersensitive to tactile stimulation around the mouth and face.
4. Children with NOFTT presented with some level of neurological dysfunction, which may have contributed to oral-motor dysfunction and their general difficulty with consuming adequate energy over the course of a meal.

From these details it can be proposed that infants with NOFTT may be experiencing a continuum of tangible hypersensitivity, in conjunction with some oral-motor difficulties, leading to an overall struggle to feed. This complex interaction may be to blame for their decreased appetite and unwillingness to consume energy.

Recommendations

The above conclusions as well as the research explored in this review give rise to a multitude of new questions that require further research. It is recommended that future research regarding NOFTT in infancy consider the following.

- a) An in-depth analysis of the Feeding Assessment Scale, further developing its validity and reliability for assessing the feeding habits of infants.
- b) Ensure the FAS or any other assessment tool used to evaluate the feeding and swallowing habits of children with NOFTT utilizes methodology that will decrease the subjectivity of observation (e.g.; offline scoring and proper blinding of researchers).
- c) Assess the presence and the role of neurological dysfunction in the feeding and swallowing habits of children with NOFTT.
- d) Evaluate the aptness of the label ‘non-organic’ for this population of children based on any reliable

neurological findings related to the etiology of their feeding disorder.

Although the limitations in the research make it difficult to apply any general principles to the assessment and treatment of infants with NOFTT, speech-language pathologists may consider some of the details presented from this research germane to their practice. However, this review does exemplify the importance of critically appraising all information prior to clinical application in order to ensure the continued safety of clients through evidence-based methodology.

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