

Published in final edited form as:

*Dev Neurorehabil.* 2011 ; 14(4): 191–198. doi:10.3109/17518423.2011.568467.

## Longitudinal changes in feeding among children with cerebral palsy Between the ages of 4 and 7 years

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### Abstract

**Objective**—To examine differences in feeding among children with cerebral palsy (CP) who varied in the severity of their oral motor involvement; to examine longitudinal change in feeding behaviors for different severity groups.

**Method**—Twenty-three children with CP participated (mean age = 4.53 years at the first time point). Feeding data were collected from parent questionnaires at 6 month intervals over 30 months.

**Results**—Significant differences were observed among severity groups for all feeding variables except coughing and choking during meals. Only one variable, coughing, showed significant change over time.

**Conclusions**—Children with CP who had severe oral-motor involvement had marked and pervasive feeding difficulties which showed some fluctuation with time, but generally were stable. Children with CP who did not have oral motor involvement and those who had mild-moderate involvement also showed little to no change over time and had fewer problems than those in the severe group.

### Keywords

cerebral palsy; oral motor skills; development; feeding

### Introduction

Children with cerebral palsy (CP) frequently have feeding and swallowing problems. Although the prevalence of oral-motor involvement among children with CP is unknown, it seems to be a relatively common occurrence. Oral motor involvement in children with CP often has a detrimental impact on feeding and nutrition [1–3]; oral, pharyngeal or esophageal dysphagia are common [3]. Examples of specific feeding problems observed in infants and children with CP include a weak suck, delayed or absent tongue lateralization, persistent tongue thrust, poor lip closure, and trunk instability resulting in problems with positioning for feeding [4]. Children with CP are at risk of being undernourished [1, 4–7], and some may benefit from tube feeding to facilitate nutritional status, growth, and overall health outcomes [2, 8].

Early management of children with CP who have oral-motor involvement can improve nutritional outcomes by providing parents with tools and strategies for managing feeding

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*Declaration of interest:* The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

challenges [9]. Treatments may include adapted eating utensils, special food textures (thickened liquids), optimized feeding posture, or placement of a nasogastric tube or a gastrostomy tube [8]. Proactive identification of children with CP who have oral-motor involvement and an understanding of how feeding and swallowing change over time in these children is necessary for the moderation of overall health risks and to improve quality of life.

A relatively small number of studies have examined feeding abilities in children with CP. One challenge with the extant literature relates to the use of severity designations. Severity levels of mild, moderate and severe are discussed throughout the literature, however the criteria used for classification into these groups has varied. For example, in some studies severity groupings have been based on variables such as growth, height, weight, skinfold thickness, or muscle tone [1, 7, 10–13]. In other studies, children have been divided into severity groups based on oral-motor abilities. Because oral-motor involvement does not always co-occur with other motor impairments, it is important that research examining feeding and swallowing or speech in individuals with CP take into consideration impairments in the relevant body functions and structures.

A key study by Reilly and colleagues [3] examined the oral-motor involvement, feeding history, and current feeding methods of 49 children with CP who were between the ages of 1 and 6 years. Findings indicated that feeding difficulties for children with CP were common during the first 12 months of life and that all preterm and most term babies with CP had been fed non-orally at least once. Further, results revealed that more than 90% of the children with CP had clinically significant oral-motor dysfunction, and 60% of the children in the study were completely dependent on caregivers for all feeding. Children with more severe gross motor involvement tended to have more severe oral motor dysfunction.

Similarly, a study by Wilson & Hustad [14], examined feeding development in 37 children with CP who were between the ages of approximately 1 and 5 years. In this study, 78% of the children had clinical oral motor involvement and 22% of the children appeared to have oral motor abilities within age appropriate limits. Results indicated that history of early feeding difficulties was similar in both groups of children. However, the children with CP who had oral-motor involvement continued to have feeding difficulties at a later age, along with a different progression in acquisition of more advanced feeding skills. Children with CP who did not have oral-motor involvement were shown to have early feeding problems that did not persist through development.

Collectively, existing studies have established that feeding and nutritional difficulties are commonly associated with CP, however the extent and type of feeding and swallowing problems and how they change over time has not been explored [15]. This information is necessary to understand the progression of feeding problems, and to understand which, if any, problems resolve on their own and which require intervention.

The goal of the present study was to examine prospective longitudinal changes in feeding for a cohort of children with CP at 6 month intervals over a 30 month period of time. The following research questions were addressed: 1.) Are there differences in feeding-related variables among children assigned to three different severity groups based on clinical observation of oral-motor integrity (i.e. children without oral-motor involvement, children with severe oral-motor involvement who were anarthric, and children with mild-moderate oral-motor involvement who were able to produce speech)? 2.) Are there different patterns of change over time in feeding-related variables for children with CP in different severity groups?

## Method

### Participants

Participants were part of a larger study on communication development in children with CP [see [16]]. Inclusion criteria were as follows: (1) confirmed medical diagnosis of CP; (2) completed 6 longitudinal data collection sessions at 6 month intervals beginning at 54 months; and (3) normal hearing per audiological screening or formal audiological test report. The data presented in this study are from 23 children (9 females, 14 males), whose mean age was 4.53 years (SD .41 years) at the first data collection session.

Children were classified into three oral-motor involvement groups by a certified speech-language pathologist with expertise in CP. Groups were: 1.) oral-motor skills within normal limits ( $n = 6$  (26%); 1 girl, 5 boys); 2.) mild-moderate oral-motor involvement ( $n = 9$  (39%); 6 girls, 3 boys); 3.) severe oral-motor involvement ( $n = 8$  (35%); 2 girls, 6 boys).

Classifications were made based on clinical observations and on assessment of the integrity of speech and feeding musculature. Children without oral motor involvement showed oral motor skills that were judged clinically to be within normal limits (WNL group). Children with mild-moderate oral-motor involvement (mild-moderate group) showed clinical evidence of neurological involvement in the speech and feeding musculature as demonstrated by at least one of the following: asymmetry of oral-facial structures during movement or at rest, drooling, or perceptual evidence of dysarthria. All children with mild-moderate oral-motor involvement were able to produce speech. Children with severe oral-motor involvement (severe group) had very limited volitional control of the speech and feeding musculature along with severe drooling and were unable to produce more than 5 words or word approximations using speech.

### Procedure & Measurement

Feeding and swallowing data used in this study were acquired from parent responses to an informal feeding and swallowing questionnaire (FSQ) completed prior to each longitudinal visit. See Wilson & Hustad [14] for information regarding the construction of the FSQ. Responses were in the form of yes/no answers and scaled ratings, which were converted to binomial responses. Specific questions that were asked at each 6 month interval pertained to: 1.) whether or not the child was using a feeding tube; 2.) whether or not the child's liquids were being thickened; 3.) whether or not any special feeding techniques (e.g. positioning adaptations, special utensils, caregiver provision of jaw support, etc.) were being implemented; 4.) whether or not the child was receiving feeding therapy; 5.) whether or not the child had received a swallow study; 6.) whether or not the child experienced choking during meals; and 7.) whether or not the child experienced coughing during meals.

## Results

With regard to differences among severity groups, results showed that there were significant differences (averaged over time) for tube feeding ( $\chi^2 = 11.32$ ;  $p = .003$ ), thickened liquids ( $X^2 = 6.16$ ;  $p = .046$ ), use of special feeding techniques ( $X^2 = 12.68$ ;  $p = .002$ ), feeding therapy ( $X^2 = 7.45$ ;  $p = .024$ ), and swallow studies ( $X^2 = 8.63$ ;  $p = .013$ ). There was no difference among severity groups (averaged over time) for choking and coughing. For variables showing significant group differences, pairwise comparisons among severity groups (averaged over time) were examined. Results revealed that there were significant differences between the WNL and severe groups for tube feeding ( $z = -2.61$ ;  $p = .009$ ), use of special techniques ( $z = -2.97$ ;  $p = .003$ ), and feeding therapy ( $z = -2.26$ ;  $p = .024$ ). In addition, there were significant differences between the mild-moderate and severe groups for tube feeding ( $z = -2.61$ ;  $p = .009$ ), thickened liquids ( $z = -1.96$ ;  $p = .05$ ), special

techniques ( $z = -2.71$ ;  $p = .007$ ), and swallow studies ( $z = -2.34$ ;  $p = .019$ ). There were no significant differences between the WNL and mild-moderate groups for any of the variables.

Results showing change over time by severity group for each of the seven variables are presented graphically in Figures 1–7. Note that the same children comprised each group at each time point. Statistical results showed that for the WNL group, only one variable, coughing, showed significant change ( $X^2 = 12.62$ ;  $p = .03$ ). For the mild-moderate group, none of the variable showed significant change over time. For the severe group, none of the variable showed significant change over time.

## Discussion

Children with CP often have oral motor involvement that leads to significant feeding and nutritional management issues. The present study was the first of its kind to examine longitudinal change over a 30 month period in feeding-related behavior in a cohort of 23 children with CP. Children who participated in the study were approximately 4 years old at the onset of the project and were separated into three different severity groups based on clinical observation of oral-motor integrity at the first data collection session.

### Differences between severity groups

Results of this study showed that there were differences in parent-report of feeding-related behavior among children in the different severity groups for five of the seven variables of interest. This finding is consistent with other studies. Further, group differences were relatively constant at the different time points, generally following a predictable pattern of children with more severe oral motor involvement having more feeding difficulties and requiring more interventions than children with milder or no clinical oral motor involvement. On many variables, children in the mild-moderate group and children in the WNL group did not differ from one another, suggesting that oral-motor problems observed clinically may not translate to feeding problems for children in the mild-moderate group. Conversely, it is possible that children in the WNL group had subtle feeding difficulties that did not manifest on clinical oral-motor and speech examination. The appropriate conclusion cannot be determined without parallel data from a group of typically developing control children.

A unique finding of the present study was that parent report of coughing and choking during meals did not differ among children in any of the different severity groups when averaged over time. This was surprising, since we expected children in the WNL group to have few or no problems on feeding-related behavior and children in the severe group to have extensive problems. There are several possible explanations for this finding. First, there was considerable variability in parent report of choking and coughing from time to time, both within and between severity groups (see Figures 6 and 7). Because children in this study were between the ages of 4 and 7 years, choking and coughing may be a reflection of food preference and defiant behavior rather than oral-motor pathology, particularly for the children who had oral-motor skills that were judged clinically to be WNL. However, because children were separated into severity groups based on observation of oral motor and speech motor behavior, which did not include a feeding observation, it is possible that children in the WNL group experienced choking and coughing because of oral-motor impairment that was not evident clinically until the child engaged in actual feeding. Such a finding would provide support for the notion that the same structures (i.e. speech musculature) can show differential involvement depending on the specific task at hand (speech vs. feeding), and that the most valid way to assess problems with a particular function is to observe that function directly rather than making inferences regarding one behavior based on observations of another [17]. Additional research is necessary to

determine whether the choking and coughing reported by parents is a reflection of impairment or a reflection of food preference behavior. Data from a control group of typically developing children without CP would help to address this question.

### Change over time

Perhaps most interesting from the present study was the finding that regardless of group membership, children with CP showed very little change in their feeding abilities and need for intervention over time. In general, children in the severe group showed more fluctuation over time than the other groups. The only variable that showed significant change was coughing. Specifically, the children with CP in the WNL group showed a significant reduction in coughing over time, but children in other groups did not show significant changes. This finding is consistent with research by Wilson and Hustad [14], which showed that children with CP who did not have oral motor involvement tended to outgrow early feeding and swallowing problems whereas children with oral motor involvement tended to have more persistent problems. Another consideration related to the lack of change over time in this study involves the notion of a critical window for oral-motor and feeding development. Because children in this study were relatively old from a feeding perspective, perhaps the window of time for significant change or skill advancement had already passed, and children had plateaued with regard to the specific variables examined in the present study. Research examining longitudinal feeding development in younger children with CP is critical to understand rates and limits of change in these children.

### Limitations

Children with CP are extremely heterogeneous. In this study we attempted to reduce this heterogeneity by separating children into severity groups based on observations of oral-motor skills at rest and during speech (or speech approximation). We then examined feeding-related behaviors based on our severity groups. A total of 23 children participated in this study, a small number considering that children were subdivided into severity groups. Conclusions from this study should be regarded with caution as a result.

Data from the present study are based on parent report and, as such, are subjective in nature. Parent report is a tool that has been used extensively for the clinical assessment of child behavior and performance. Parental responses have been shown to be valid in regard to measures of gross motor function [18] and of neurodevelopmental outcome [19]. Parent report has been used throughout the literature to measure feeding and oral-motor status in children with CP [1, 3, 4, 13]. However, data obtained from behavioral observation by a third party would add additional validity, and perhaps refinement, to the measures reported in the present study.

### Conclusions

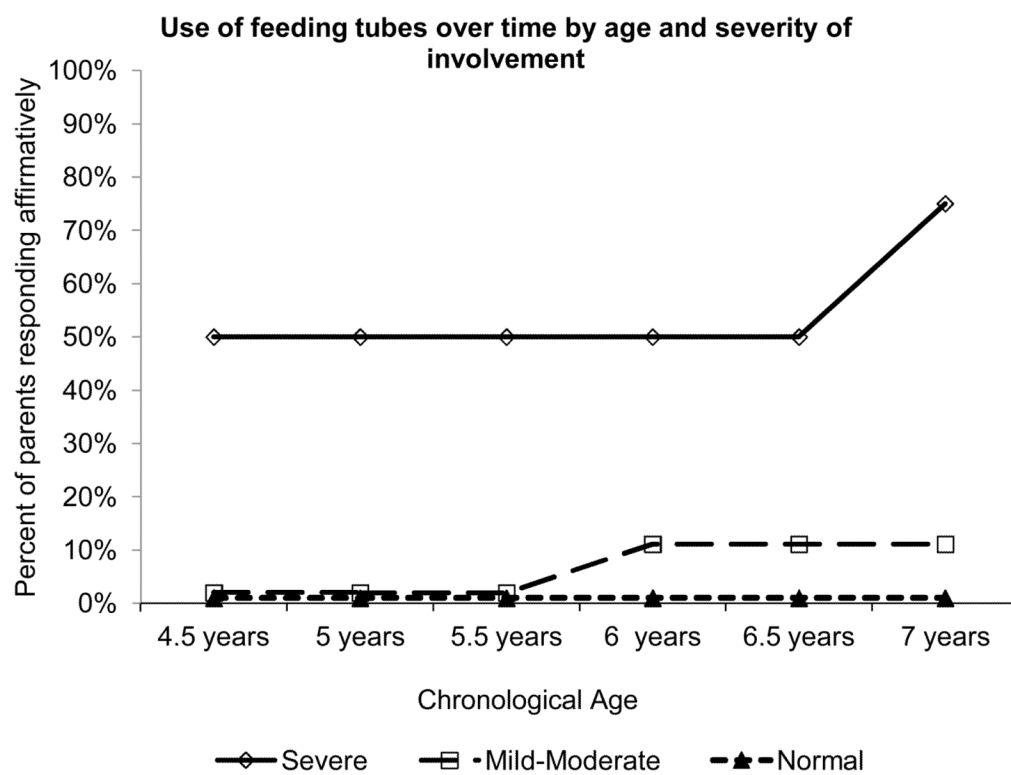
Regardless of severity, most children with CP were reported to have difficulty with coughing and choking during meals. However, relatively few children received a swallow study or feeding therapy in spite of these symptoms. Findings may suggest that children with CP are underserved with regard to feeding therapy. Further, findings seem to suggest that children who do not have frank oral-motor problems may, in fact, have symptoms of feeding problems that require professional evaluation involving assessment of feeding.

### Acknowledgments

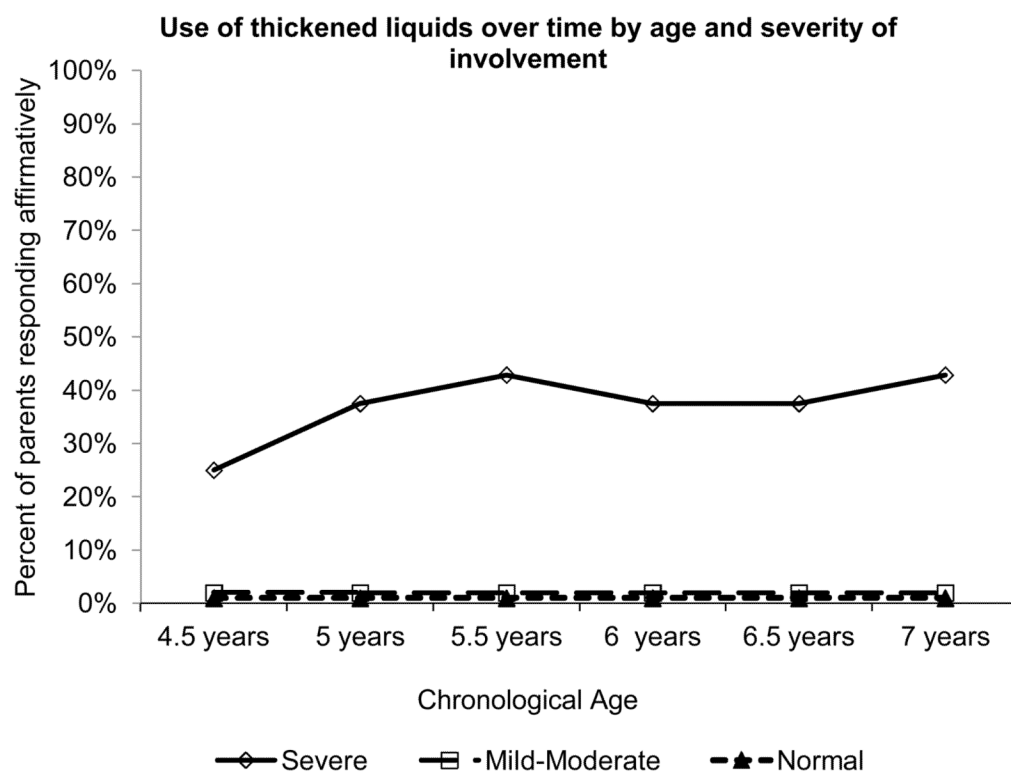
We thank the children with CP and their families who participated in this study. This research was funded by grant R01DC009411 from the National Institute on Deafness and Other Communication Disorders, National Institutes of Health.

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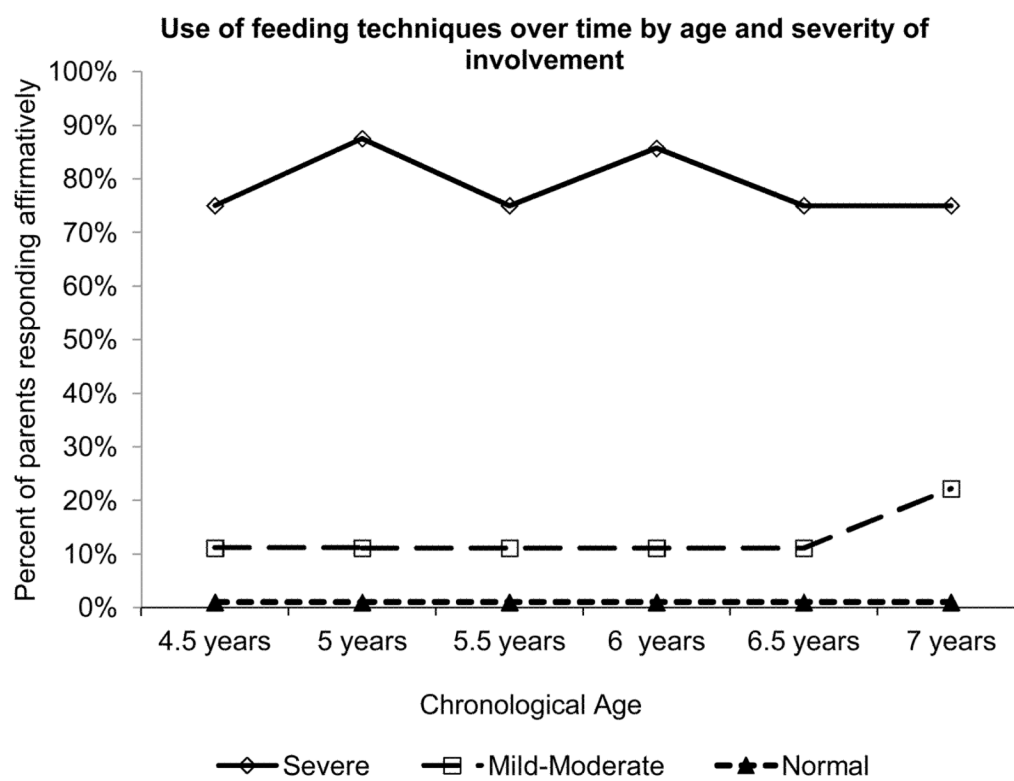
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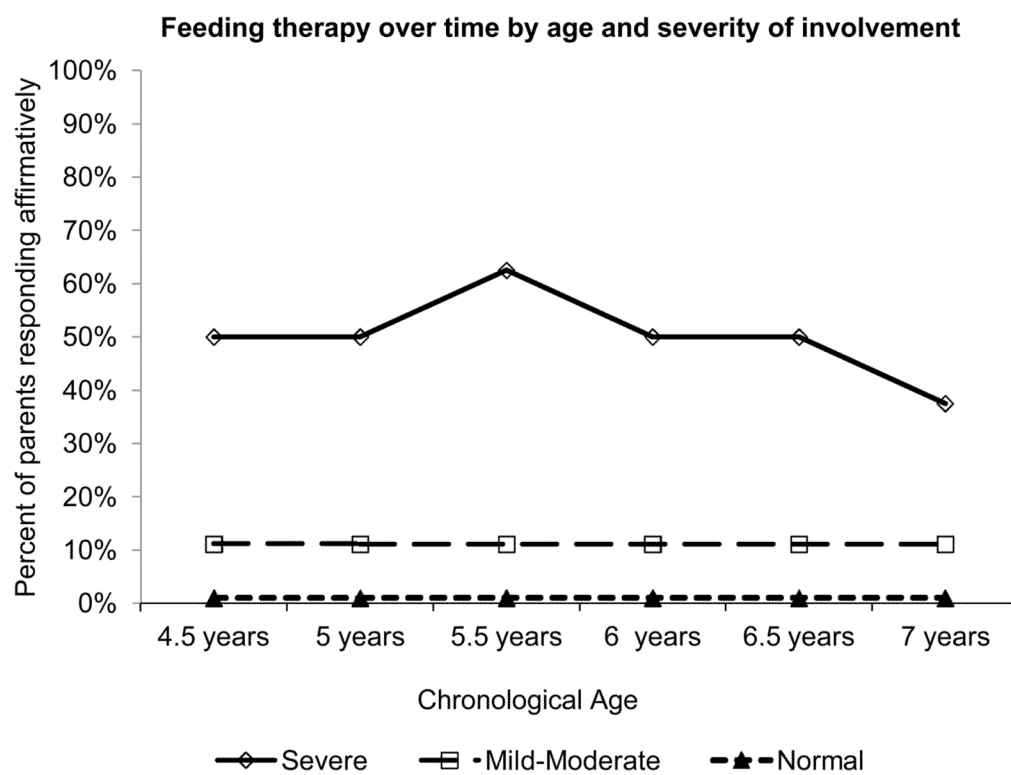
**Figure 1.**



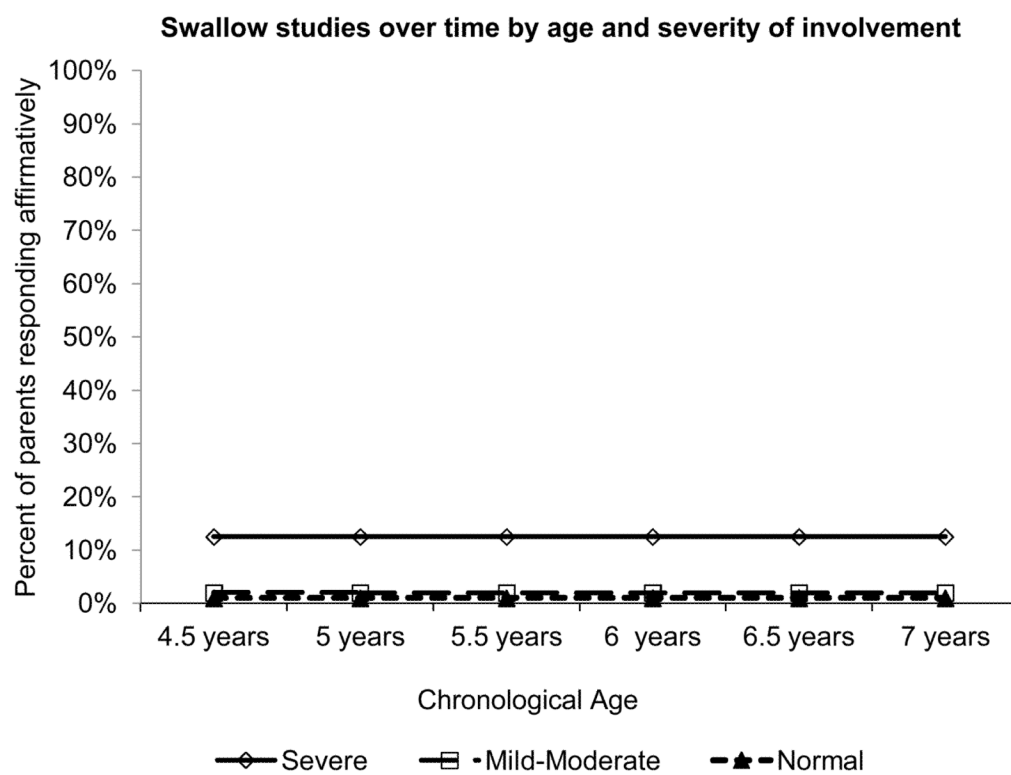
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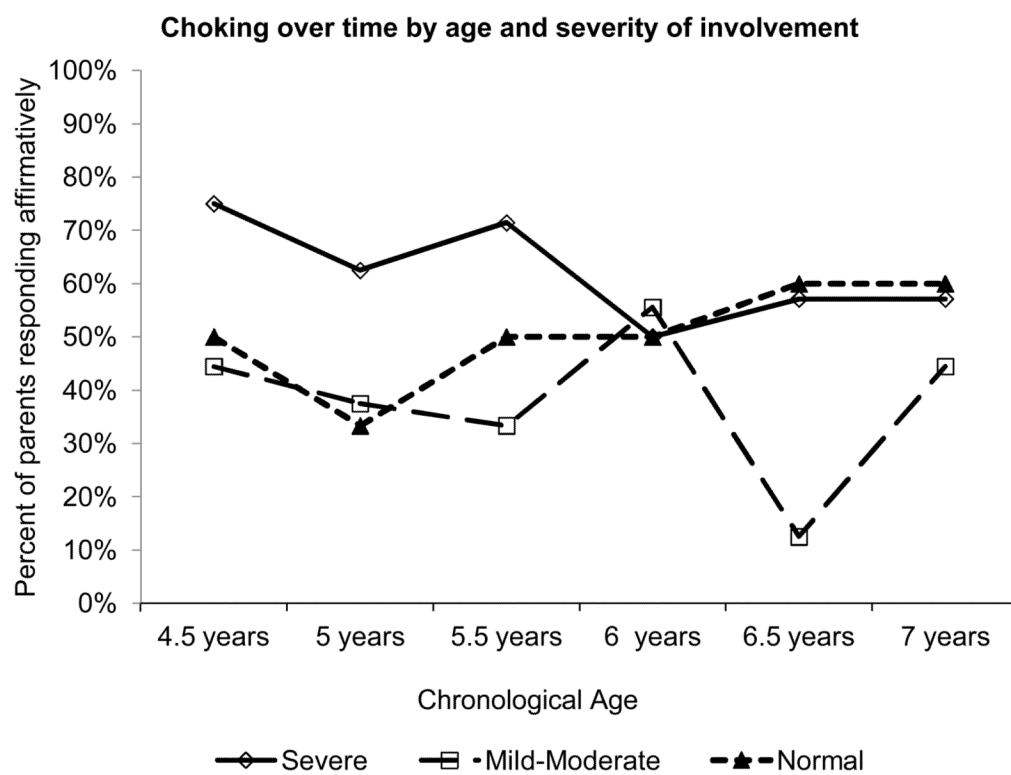
**Figure 3.**



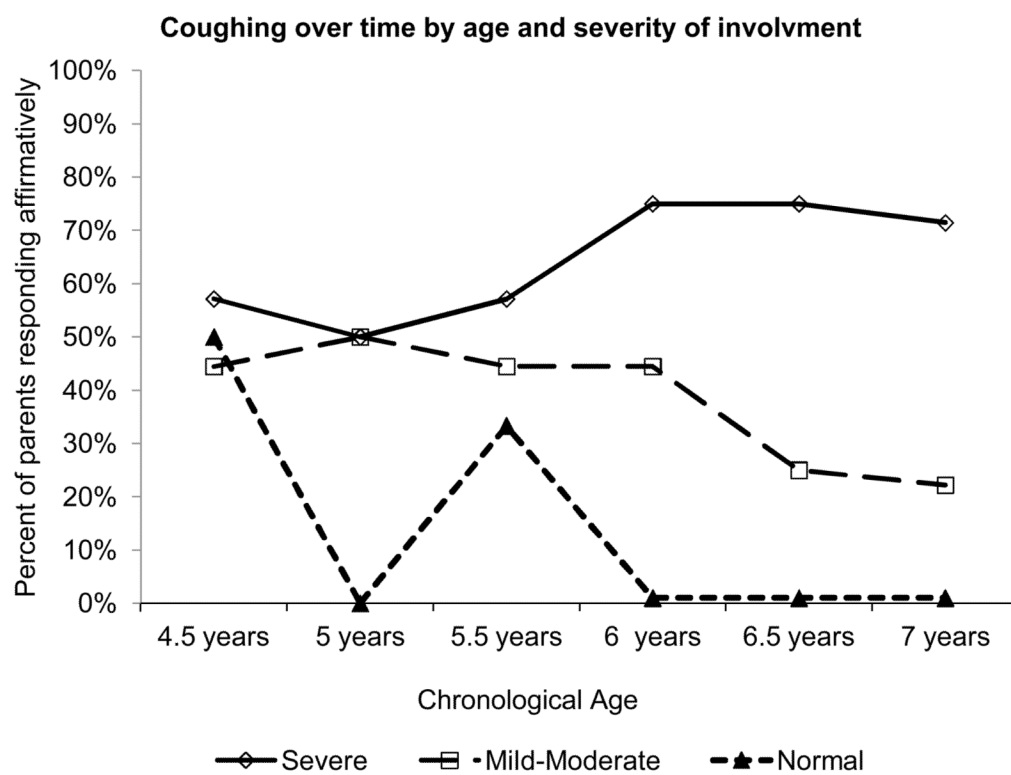
**Figure 4.**



**Figure 5.**



**Figure 6.**



**Figure 7.**