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Review Article

Feeding Difficulties among Children with Cerebral Palsy: A Review

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ABSTRACT

The objective of this article is to review the studies conducted among children with cerebral palsy to assess their feeding problems and its impact on child's growth and nutritional status. Feeding problems are quite prevalent among CP children. Some of the common feeding problems include problem in chewing, sucking and swallowing, inability to self-feed, coughing and choking during feeding, vomiting and drooling. Factors like oral motor dysfunction, severity and type of CP, postural problems and age are responsible for their prevalence. These can have a negative impact on the child's growth, nutritional status and quality of life. Emphasis should therefore be placed on an early identification, treatment and correction of feeding problems. Significant improvement in child's health and nutritional status can be achieved through intensive intervention programs. Increasing awareness among caregivers/parents, government and health care providers, regarding the needs of children with disabilities and their feeding difficulties is urgently warranted.

Key Words: cerebral palsy, OMD, intake, feeding, malnutrition

INTRODUCTION

Feeding is one of the principal activities required to assure good health and wellbeing among individuals.[1] It requires neuromuscular coordination and conjunction of motor and sensory organs.[2] Feeding skills appear in a fixed sequence in normally developing children and is associated with the successive attainment of motor, language and social landmarks.[3] Children with Cerebral Palsy (CP) having functional neurological damage, often have several disorders along with discordant movements resulting in feeding difficulties.[4] These children can have difficulties during all stages of eating and drinking.

Some of the common feeding problems that have been reported among this group include difficulties with self-feeding, chewing and swallowing, [5-7] food refusal, problems with biting and sucking, drooling, food/fluid loss during feeding, and sequencing and rhythmicity difficulties. [8] Feeding dysfunction (FD) has been identified as one of the main factors contributing to undernutrition among these children. [1,7,9-12]

Prevalence of feeding dysfunction

Feeding problems are quite prevalent among these children.[1,11,13-17] Its prevalence varies widely across different studies (Table 1). Variation could be due to difference in

inclusion criteria of age, motor involvement and different definitions and techniques used for assessment of feeding problems. Across various studies, it can be seen that feeding problems are more among younger children and in those with moderate to severe CP.

Table 1: Prevalence of feeding problems among CP children

S.No.	Study	Locale	Sample size	Description of sample	Prevalence of feeding problems
1.	Dahlseng et al. (2012) [11]	Norway	661 (mean age: 6 years 7 months)	All types of CP included	30%
2.	Sullivan et al.(2000) [6]	US	271 (4-13 years)	All types of CP included	34%
3.	Fung et al. (2002) [1]	US and Canada	230	Included moderate-severe CP only	58%
4.	Dahl et al. (1996) [18]	Sweden, Retrospective study	35 (2-15 years)	Included only moderate to severe CP	60%
5.	Gangil et al. (2001a) [15]	India, Hospital based study	100 (1-9 years)	Included mostly severe cases of CP	70%
6.	Sjakti et al. (2008) [14]	Indonesia, Hospital based study	55 (1-10 years)	Included mostly SQCP	76%
7.	Walker et al. (2012) [19]	Australia	73 (1-5 years)	Mostly SQCP	76%
8.	Ghayas (2013) [20]	Pakistan	122 (3-15 years)	Included only moderate to severe CP	100%

Nearly 70% children had marginal and inadequate feeding skill score in a perspective Indian hospital based intervention study [15] (n=100) having severe form of CP. Nearly all the children in the study sample had one or the other type of feeding problem. Similarly, 76% children were reported to have feeding problems in an Indonesian hospital based study [14] (n=55), mostly having Spastic Quadriplegic CP (SQCP). In another study [19] (n= 73), mostly having spastic CP, sixty seven percent had FD. In another study [20] conducted among 122 CP children, nearly all the children had some feeding problem.

Factors contributing to feeding dysfunction

1. Oral Motor Dysfunction (OMD)

OMD is one of the prime contributing factor to FD. [8,11,14,15,18,20-27] Types of OMD include sucking and swallowing difficulties, drooling, poor lip closure and perioral hyposensitiveness/ hypersensitiveness. Less prevalent OMDs include tongue thrust, limited tongue movement, choking, persistent bite reflex, jaw instability, poor respiratory coordination, poor gag reflex, lip retraction and primitive chewing reflex. [14] Presence of OMD has been significantly associated with more difficulty in self-feeding, increased chances of coughing and choking and late introduction of solid food. [24] High prevalence of OMD has been reported by several researchers (Table 2) specially among younger children [8,15,24] and those with moderate to severe CP. [14,15,20]

2. Severity of Gross motor impairment

There is a positive association between severity of motor impairment and FD. [6,8,10,26,28-30] Children with more severe gross motor involvement (GMFCS VI & V) have severe FD. [1,8,11] In a study conducted among 230 children having severe CP, 94% of the subjects who had severe FD belonged to GMFCS V. [1] Similarly, in another study (n=120 children; All types of CP included), high prevalence of FD was reported among GMFCS IV & V ($p<0.0001$). [31] Calis and colleagues [29] also showed a positive association of FD with severity of motor impairment ($p<0.001$) among 166 children (2-19 years) with only severe forms of CP. Reilly and colleagues [8] conducted a study

with 49 children with mostly severe forms of CP also showed a positive relation between FD and gross motor severity (p=0.000). However a group of researchers [21] reported that these studies lacked in the use of direct objective measures of oral sensorimotor skills, [1,6,8,28,30,31] use of validated measures of gross motor skills[6] and included children with only moderate-severe gross motor impairment. [1,29,32]

Table2: Prevalence of OMD in CP children

S.No.	Study	Locale	Sample size	Description of sample	Prevalence of OMD
1.	Vik et al.(2001) [26]	Norway, Hospital based study	154 (3-19 years)	Included all types of CP	26%
2.	Thommessen et al.(1991a) [9]	Norway, Institution based cross-sectional study	42 (1-16 years)	Included all types of CP	33%
3.	Sjakti et al.(2008) [14]	Indonesia, Hospital based study	55 (1-10 years)	Included mostly SQCP	56%
4.	Field et al.(2003) [5]	US	44 (0-12 years)	Included only severe forms of CP	68%
5.	Stallings et al.(1993a) [10]	North America	142 (2-18 years)	Included only SQCP	86%
6.	Wilson and Hustad(2009) [24]	United States	37 (1-5 years)	Included all types of CP	78%
7.	Reilly et al.(1996) [8]	US	49 (1-6 years)	Mostly with severe CP	90%
8.	Gangil et al.(2001a) [15]	India, Hospital based study	100 (1-9 years)	Included mostly severe cases of CP	100%
9.	Ghayas, (2013) [20]	Pakistan	122 (3-15 years)	Included only moderate to severe CP	100%

GMFCS has been significantly related to swallowing/chewing difficulties and excessive drooling. [28] A significant correlation between severity of motor impairment, choking ($p<0.001$) and prolonged mealtime ($p<0.001$) has also been reported. [6] Children with severe functional limitations (GMFCS IV or V) commonly need assistance while feeding. [1,33,34]

3. Type of CP

Various types of CP have been associated with greater occurrence of feeding problems. Children with SQCP, are at a greater risk of feeding problems. [1,6,8,11,14,15,26,35] Tetraplegia [8] ($p=0.001$), hypotonia [15,35] and dyskinetic [6,11] subtypes of CP has also been associated with more FD. [8] Hypotonic patients have significantly poor feeding skill score ($p<0.001$) and poor OMD as compared to diplegic and hemiplegic patients. [15] In a study children with dyskinesia had more swallowing difficulties [8] whereas children with spastic unilateral, spastic diplegia and ataxic CP were mostly independent compared to SQCP. [11,36]

4. Speech and communication disorders

Poor speech is also related to a high prevalence of FD. [11,14] Children with normal to slightly imprecise speech have better feeding ability as compared to those having severe speech impairment. [4] Many of these children are not able to request food and drink because of speech impairment. [15] It was reported that 81% of the children, in a study, [11] in the "no speech group" were totally dependent for feeding or were tube-fed. Whereas 95% children in the normal speech group could eat on their own. It was also seen that even slightly preserved speech intelligibility significantly improved the feeding ability.[11] Poor speech has also been associated with longer meal time, coughing, choking, aspiration, respiratory and swallowing problems. [37]

5. **Postural problems**

An effective feeding process depends on good posture control. [14,38] Poor posture results in a weak head and trunk control and an inability to maintain body position. [39] Neck hyperextension leads to tongue retraction, [40] depressed mandible, [41] and swallowing disorder, and an increase in tendency to aspirate. [42,43] Successful intake of food depends on the coordinated movements of tongue, lips, and jaw, which depends on the head and trunk control. [44,45] Correct positioning of head and body during feeding can help in protecting the airway [16] and also ensures stability of head and oral structures. This in turn, will lead to improvements in movement of oral structures and help reduce the risk of aspiration. [38,46] SQCP children are found to have poor postural control and received inadequate calorie intake as compared to diplegic patients. [14,42]

6. **Age**

Feeding difficulties are common in all the age groups. [8,47] But an early age has been associated with prevalence of more number of feeding problems such as weak suck, delayed or absent tongue lateralization, persistent tongue thrust, poor lip closure, and trunk instability. [1] Ninety percent of the children in a study had OMD, 57% had problem in sucking, 38% had swallowing problem and 80% were being fed non-orally at least once during the first year of life. [8] Presence of OMD from an early age can lead to continued feeding difficulties at a later age. They can also have problems in acquiring more advanced feeding skills at a later age. [24] Vik and colleagues [26] also reported a decrease of OMD from 50% in the youngest children to about 30% in elderly. But the difference was not statistically significant ($p = 0.17$).

7. **Other factors**

Factors such as gender, [48] occurrence of seizures, [14-16,20,49] cognitive/intellectual impairment, [14,26,28,29,47] and presence of a feeding tube[1] also have associated with higher prevalence of feeding problems among these children. Males have a higher prevalence of OMD ($P < 0.01$) as compared to females. [48] Feeding problems such as swallowing, coughing/choking, vomiting, recurrent chest infections, drooling and regurgitation are significantly more common in children with seizures ($p<0.001$). [15,20]

Parental awareness about feeding problems

It is important for parents to report feeding problems encountered by their children. Absence of complaints, in no ways means that feeding problems do not exist. [14] Parents are largely unaware about the disease and its associated problems. Also, they do not appreciate the feeding problems to the extent that they should because of the deep psychological impact they have of having a neurological impaired child at home. [15,20] Very few studies have made comparison between the prevalence of feeding problems reported by parents and those that actually exists. [14,15,20,46,50] Study conducted in India among low socio-economic group revealed that parent's awareness about their child's feeding problems was significantly low and they tended to overestimate their child's nutritional status. Nearly 10% of the parents did not realize feeding difficulties to be of any significance until counseling was done. [15] In another Indonesian study, 38% parents were not aware of the feeding problems encountered by their children. [14]

Nature of feeding difficulties

Neurological lesions can have an impact on the muscles of jaw, cheeks, lips, tongue, palate and pharynx. [30] They functionally manifest as difficulties with eating, drinking, swallowing, speaking and controlling saliva. [21] Common feeding problems among CP children include

sucking and swallowing problem, inability to self-feed, regurgitation, coughing and choking, recurrent chest infections, OMD, vomiting, cry/extensor dystonia, drooling, hypertonic tongue and inadequate tongue lateralization. [15,20] Prevalence of some of the common feeding problems is discussed as follows:

1. Inability to Self-Feed: CP children are often unable to eat on their own. They often need help while feeding. Its prevalence varies from 20% to 90% among various studies. A higher prevalence was reported in those studies which included only severe forms of CP (Table 3).

Table 3: Prevalence of Inability to self-feed in CP children

Study	Locale	Sample size	Description of sample	Prevalence of inability to self-feed (%)
Dahlseng et al.(2012) [11]	Norway	661 (mean age: 6 years 7 months)	All types of CP included	21
Vik et al.(2001) [26]	Norway, Hospital based study	154 (3-19 years)	Included all types of CP	34
Karagiozoglou-Lampoudi et al.(2012) [33]	Greece	42 (2-15 years)	Mostly had SQCP	40
Wilson and Hustad(2009) [24]	United States	37 (1-5 years)	Included all types of CP	44
Reillly et al.(1996) [8]	US	49 (1-6 years)	Mostly with severe CP	60
Sullivan et al.(2000) [6]	US	271 (4-13 years)	All types of CP included	89
Gangil et al.(2001a) [15]	India, Hospital based study	100 (1-9 years)	Included mostly severe cases of CP	90

2. Longer Duration of feeding: These children often take longer duration to eat as compared to normal children. [22,51,52] Parents have reported mealtimes to be stressful and time consuming. It can take up to 7 hours a day to feed these children. Mealtimes are often interrupted with repeated spillage of food, coughing, choking and regurgitation. [20] Sullivan and colleagues [8] reported that nearly a third of the children in their study took more than 3 hours a day to finish their meals. A similar prevalence of 38% was reported by another study. [14] Several studies have reported the mean duration of feeding session among these children to be 30 minutes (range 10-60 minutes). [15,20,26,53] Children with more number of feeding problems took longer to eat. [15,26,52]

3. Drooling: Presence of saliva outside the mouth, or drooling, [14] is a problem in approximately 15% [14] to78% [30] of the children with CP. In a study it was reported that nearly half of their study sample had drooling problem. [15] A slightly lower prevalence (22%) was reported by another study. [28] On the contrary to the problem of drooling, these children can also present with a low salivary flow rate, pH and buffer capacity. [54] This can be attributed to low liquid diet intake because of compromised oral motor performance or offering low amount of liquids to them resulting in an inadequate hydration status.

4. Swallowing Problem: Swallowing is one of the most common difficulties observed among these children. [4,5-7,14,23,55] Problems of aspiration, choking and coughing are also a sign of swallowing disorder. [6,14,15,23] Its prevalence varies from 18% to 80% in CP children (Table 4).

Table 4: Prevalence of dysphagia in CP children

Study	Locale	Sample size	Description of sample	Prevalence (%)
Ghayas(2013) [20]	Pakistan	122 (3-15 years)	Included only moderate to severe CP	18 (swallowing)
Erkin et al.(2010) [31]	Turkey	120 (2-12 years)	Included all types of CP	19 (swallowing)
Waterman et al.(1992) [30]	US	56 (5-21 years)	Included all types of CP	27 (swallowing), 32 (coughing)
Wilson and Hustad(2009) [24]	US	37 (11-58 months)	Included all types of CP	56-69% (coughing/ choking)
Sjakti et al.(2008) [14]	Indonesia, Hospital based study	55 (1-10 years)	Included mostly SQCP	57 (swallowing), 33 (coughing/choking)
Gangil et al.(2001a) [15]	India, Hospital based study	100 (1-9 years)	Included mostly severe cases of CP	63 (swallowing), 62 (coughing/choking)
Reilly et al.(1996) [8]	US	49 (1-6 years)	Mostly with severe CP	71%
Sullivan et al.(2000) [6]	US	271 (4-13 years)	All types of CP included	79 (swallowing), 56 (coughing/choking)

These studies have used different methods and scales for assessment of swallowing problems. Also, there is a lot of heterogeneity in the group of children recruited. Children vary in terms of severity, type of CP and age. These children can also have difficulty in swallowing thin liquid foods. [56-58]

Various factors such as bite reflexes, slowness of oral intake, poor trunk control, inability to feed independently, anticonvulsant medication, coughing with meals, choking, and pneumonia were identified as factors contributing to dysphagia. [30] Other factors such as presence of tongue thrust, drooling, severity of CP, poor head control, severity of mental retardation, seizures, and speech disorders also have an impact on swallowing. [30] Some researchers have also related prevalence of swallowing problem with age, [47] OMD [24] and severity of CP. Motion and colleagues [47] reported that the prevalence of swallowing problem reduced from 46% to 18% as the age advances.

5. Chewing problem: Chewing food with viscous and solid textures is difficult for children having eating impairments. [59] They often have difficulty in transitioning to solid food [24] and can better withstand liquid and/or semi-solid diets. Croft [37] reported that children having chewing problem, had more difficulty in having lumpy food as compared to mashed food. They might also experience severe distress due to the same. It is therefore recommended that these children should be offered food that cause least distress and frustration. This might also help in improving their food intake and nutritional status.

Nearly 80% of the parents of children with CP reported their children to have difficulty in chewing. [6,15,20] Gangil and colleagues [15] reported that the main food of 45% of CP patients in their study was liquids and semisolids. Children with a normal feeding skill score consumed mainly liquid plus semisolid and/or solid diet but those having an inadequate feeding skill did not receive any solid food. Parents found it easier to feed liquid diets to those who had OMD. In another study, it was reported that only 22% of the children (n=122) had a liquid plus semi-solid plus solid diet. Rest 78% had only a liquid and/or semi-solid diet. It was also seen that those children who had a normal or marginal feeding skill score mainly consumed liquid plus semisolid and/or solid diet. But those who had an inadequate feeding skill score, did not receive any solid food. [20]

6. Gastro-esophageal Reflux Disease (GERD) and Vomiting: Around 70-75% of children with CP encounter

gastroesophageal reflux disease. [16,60] Common symptoms of GERD include severe feeding difficulties, vomiting, failure to thrive, anemia, and repeated chest infections. [60] Prevalence of 31.3% was reported in a study conducted among 80 CP children. [49] One study reported a higher prevalence of reflux in 1-2 years age group ($p < 0.001$) and in females ($p < 0.001$). [49] Along with GERD, frequent vomiting has also been reported in these children. Gangil and colleagues [15] reported that 23% children in their study sample (n=100) had problem of frequent vomiting. Similar figures were reported by 2 other studies: 24% [18] and 22%. [6]

7. Other problems: Other less prevalent problems among this group include inadequate tongue movement, sucking problem, wide opening of mouth, bite reflex and jaw instability. Inadequate/absent tongue lateralization was observed in 84% [15] and 6% [14] of the children with CP. Forty three percent children were reported to have a hypertonic tongue. [15] Whereas, tongue thrust was reported in 6% [20] and 7% [14] of the children. Inadequate sucking has also been reported among 20-60% of children with CP in a few studies. [14,15,24]

In a study it was seen that 20% children had difficulty in getting food off spoon with lips, eighteen percent took longer time to swallow bites of food and in 16% food and liquids leaked out of corners of mouth. [20] No lip closure around spoon by children with CP was reported by 2 other studies, being 20% [15] and 14%. [14] Fourteen percent children were also reported to have the problem of wide mouth opening while eating. [15]

Bite reflex, jaw instability and poor respiratory coordination were reported in 5% of the study sample. [14] A few researchers have reported children with CP to have the problem of constipation. This problem ranges from 25-30% of children with CP. [6,15,31]

Management of feeding difficulties

CP can have major health consequences over an individual's lifespan. [1] It can have a negative impact on their quality of life as well. [1,20] Feeding difficulties can affect an individual's growth and nutritional status. [9,10,17,18,52,61-63] Poor nutritional status may be caused either due to inadequate food intake, swallowing disorder, GERD or chronic aspiration. Besides poor growth, malnutrition can also hamper a child's social, emotional and cognitive development. [64] It may lead to increased irritability, decreased motivation and energy for activities such as play, learning and training. [1,10,62]

The primary goal of management of CP should therefore be improving the quality of life of both the child and the family. Focus should be laid on maximizing independence in activities of daily living, mobility and nutrition. Multiple approaches such as sensorimotor stimulation, positioning, food thickeners, and caloric supplementation may be used to improve growth among this population. Sensorimotor techniques help in strengthening oral motor control and resolve abnormal tone and reflexes. Positioning techniques help in stabilizing neck and trunk which in turn exacerbates swallowing difficulties. Stability of jaw, lip control, improvement in sucking, chewing and tongue coordination can be achieved by using oral appliances. [65] Surgical interventions with gastrostomy or jejunostomy may also be required in children with moderate to severe aspiration or malnutrition along with anti-reflux procedures to improve their nutritional status and reduce the risk of chronic aspiration. [34,66]

Studies have been conducted in various parts of the world to improve the nutritional status of these children. Most of

them have been conducted in well-resourced countries where high- and low-cost medical options for intervention are greater, ranging from gastrostomy tube feeding to caregiver training. Researches on appropriate interventions lack for families in resource poor countries. [20] Nasogastric feeding has shown improvements in CP patients in terms of low subcutaneous fat, cold peripheries, and stunted growth. [25,29] Subjects who were tube fed were taller (p=0.014) and had greater body fat stores (triceps z score, P=0.001) than orally fed subjects with similar motor impairment. [1] Sullivan and colleagues [67] also reported a statistically significant increase in weight and subcutaneous fat deposition among their study sample. Gastrostomy tube feeding is also associated with an increased life expectancy in these children. [68] Another cohort study [1] reported less respiratory illness in children with CP who were fed by gastrostomy. Studies [35,69] have also demonstrated a significant, measurable improvement in the quality of life of carers after insertion of a gastrostomy feeding tube. Carers in one of the study [69] reported significant improvements in social functioning, mental health, energy/vitality, and in general health perception (p=0.045) compared with results at baseline.

Oral motor therapies in younger children with OMD, admitted to a hospital, given 4 times a week, showed improvements in the speaking, eating skills, and a reduction in drooling. Therapy included modifications in seating and head position, practicing lip closure, jaw control, breathing, swallowing, and tongue movements. However, improvement in chewing was limited. [37] In an Indian hospital based intervention study, nutritional rehabilitation showed good improvements in feeding problems, OMD and nutritional status of CP children. [15] Nutritional rehabilitation included oral sensorimotor normalization for hypersensitive areas inside and outside the mouth, postural improvement and reduction of extensor dystonia reaction. Other changes included: change in consistency of food, increasing caloric intake, tube feeding for acute illness, jaw control and technique to reduce tactile hypersensitivity to reduce drooling. Parents and siblings were also educated about CP and its associated problems. Improvements were seen in cough/choking during feeding, vomiting, swallowing and restricted temporomandibular joint movements. OMD was also reduced in 13.3% cases with normal feeding score, 54.8% cases with marginal and 25% cases with inadequate feeding skill score. A shift from only liquid diets to liquid plus semi-solid diets was seen along withan improvement in nutritional status of 40% children.

A low-cost intervention study conducted in Bangladesh among 37 underprivileged caregivers and their children with moderate-severe CP showed significant improvements in the children's respiratory health ($p = 0.005$), cooperation during mealtimes ($p = 0.003$) and overall mood ($p<0.001$). Caregiver stress reduced dramatically ($p <0.001$). Improvements in growth were inconsistent. [53] Intervention focused on improving dietary intake and feeding by introducing calorie-dense, balanced diets, adapting consistency of food, using appropriate utensils and improving posture. Authors concluded that even in situations of extreme poverty, caregivers were able to change feeding practices after a short, low-cost training intervention. However, an urgent attention needs to be paid to the availability of affordable food supplementation for this population.

CONCLUSION

Children with CP experience difficulties during eating and drinking, which if not managed properly may result in

stressful mealtimes, chronic malnutrition, respiratory disease, reduced quality of life of child and caregiver and reduced life expectancy. [53,70] Further, lack of medical care facilities, cultural barriers, minimal formal education and extreme poverty, worsen the condition of disabled children in developing countries. [20,71] Emphasis should be therefore placed on an early identification, treatment and correction of FD. [1,18,23] Management of feeding problems should co-exist with timely assessment of growth among these children. [14,53] Increasing awareness among caregivers/ parents, government and health care providers, regarding the needs of children with disabilities and their feeding difficulties is urgently warranted. [53]

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