A study to assess the factors associated with developmental delay and nutritional status among the children with cleft lip and/or cleft palate

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ABSTRACT

Background: Cleft lip with or without cleft palate is one of the most common congenital anomalies. Development is often affected in these children. It may be due to other associated defects, syndromic status, or malnutrition. **Objective:** The objective of this study was to assess the factors associated with developmental delay and nutritional status among the children with cleft lip and/or cleft palate. **Materials and Methods:** A cross-sectional study was conducted at the Department of Pediatrics of a Medical College in Sawangi (Meghe), Wardha, for 2 years from August 2010 to March 2012. All children below 15 years with cleft lip and/or palate admitted in the pediatric ward, the neonatal intensive care unit, or postnatal ward were included in the study. A total of 200 children were included in the study and were analyzed for developmental delay and growth lag. **Results:** Cleft clip was seen in 51 (25.5%) of the children, 25 (12.5%) had cleft palate, and 124 (62%) had both cleft lip and palate. Developmental delay was more common in cleft palate category; however, it was not statistically significant (χ^2=0.90, p=0.34). Unilateral form of defects had more number of delays as compared to bilateral defects, and it was statistically significant (χ^2=7.32, p=0.006). Delay was more common when both the defects were present together as compared to isolated defects; however, it was not statistically significant. Gross motor and language delay were the most common type followed by global and personal social. 12.5% of children were syndromic. Most of the syndromic children (64%) had global developmental delay (χ^2=7.84, significant). 69.6% of children below the age group of 5 years were malnourished (χ^2=16, significant). Faulty feeding (73.5%), recurrent respiratory infections (21.4%), and repeated hospitalization (17.1%) were the statistically significant factors for poor growth. **Conclusion:** Global developmental delay was more common in syndromic children. Overall, delay was more commonly seen in children with unilateral defect. Factors, which contributed to growth lag, were faulty feeding, recurrent respiratory infections, and repeated hospitalization.

Key words: *Children, Cleft lip and palate, Developmental delay, Malnutrition*

Cleft lip with or without cleft palate is one of the most common congenital anomalies [1]. In 2008, the World Health Organization (WHO) included cleft lip and palate in their Global Burden of Disease initiative [2]. The exact cause for cleft lip and/or palate is not known. Most of the orofacial clefts, like most other congenital anomalies, are caused by the interaction between genetic and environmental factors. The genetic factors create susceptibility for clefts, leading to defective differentiation, proliferation, and migration of cranial neural crest cells results in these developmental defects [3]. When environmental factors (i.e. triggers) interact with a genetically susceptible genotype, a cleft develops during an early stage of development [4].

Epidemiological and experimental evidence suggests that environmental risk factors such as maternal exposure to tobacco smoke, alcohol, poor nutrition, viral infection, medications, and teratogens in the workplace and at home in early pregnancy are important factors in etiology. The role of maternal nutrition and, in particular, multivitamins in orofacial clefts remains unclear. Furthermore, assessment of dietary intake or biochemical measures of nutritional status is challenging and often not available in many impoverished populations with the highest rates of orofacial clefts. Effects on reproductive health need further elucidation [5]. Certain types of antiepileptic drugs have also been reported to increase the risk [6-8]. The growth of children with these deformities is often impaired in comparison to healthy children.

Apart from growth, development is another important aspect of childcare. Development may be affected in these children due to other associated defects, syndromic status, or malnutrition. Children with cleft lip/cleft palate are at high risk for speech and language disorders [9]. Intervention programs are the most effective tools to counter the detrimental effects on growth and development. Evaluation of speech and language development provides information that is

needed by the team in planning speech management. In India, early forms of surgical intervention are also becoming a reality consequent to the efforts by non-profit organizations such as the "smile train" which significantly reduces the speech problems due to the defect. This study was done to focus on the growth and developmental status of the children with cleft lip and cleft palate and to assess the etiological factors associated with growth lag and developmental delay with special emphasis on feeding pattern.

MATERIALS AND METHODS

A cross-sectional study was conducted in 2012 at the Department of Pediatrics of a Medical College in Sawangi, Wardha. All children 15 years of age with cleft lip and/or palate admitted in the pediatric ward, the neonatal intensive care unit, or postnatal ward were included in the study. The children were classified into different groups based on the type of defect as follows:

1. Cleft lip: (a) Unilateral and (b) bilateral
2. Cleft palate: (a) Unilateral and (b) bilateral
3. Both defects: (a) Unilateral and (b) bilateral.

All the parents of children with cleft lip/palate were interrogated to get detailed information about feeding practices, problems faced during feeding with special emphasis on breastfeeding. Anthropometry was recorded and anthropometric parameters were plotted on the WHO growth charts for children up to 5 years of age and on Indian Academy of Pediatrics (IAP) growth charts for children >5 years of age. Malnutrition was graded for children up to 5 years of age as per IAP classification into Grade 1–4 protein-energy malnutrition (PEM) and as per the WHO classification into severe acute malnutrition (SAM) and medium acute malnutrition (MAM). Detailed head to toe examination and systemic examination were done. Dysmorphic or syndromic features, if present, were noted and the case was labeled as a particular syndrome after referring the textbook, Smith's recognizable features of human malformation [10].

Developmental history was enquired in detail. Time of attainment of all the gross motor, fine motor, language, and personal social milestones was recorded. Developmental assessment was done by a two-tier screening method using Trivandrum development screening chart (TDSC) [11], which can be used for children up to the age of 2 years and Denver developmental screening test II (DDST II) [12], which can be applied till the age of 6 years. First, the development of children up to the age of 2 years was assessed using TDSC (a simple screening test consisting of 17 test items). If developmental delay was detected, then they were further subjected to DDST II (an advanced screening test consisting of 125 test items) which specifically detects developmental delay in all the four domains - gross motor, fine motor-adaptive, language, and personal social including test for the behavior assessment. Children between 2 and 6 years of age were directly subjected to DDST II.

As far as language delay was concerned, a child was labeled as a case of language delay only if both receptive and expressive components of language were affected as expressive speech is affected in majority of the patients where palate is involved and if only expressive speech is taken into account, then these children can be falsely labeled as a case of language delay. In case of syndromic children, development was assessed even if they were >6 years using the standard method of developmental assessment [13]. All these data were collected in a pretested, semi-structured questionnaire, and analyzed using SPSS 21.0 version and Statistical analysis was done using descriptive and inferential statistics using Chi-square test.

RESULTS

Of 200 children included in the study, 118 (59%) were male and 82 (41%) were female. 36 children were >1 years, 27 children between 1 and 2 years, 21 children between 2 and 3 years, 20 children between 3 and 4 years, 8 children between 4 and 5 years, 3 children between 5 and 6 years, and 85 children between 6 and 15 years of age. Cleft clip was seen in 51 (25.5%) of the children, 25 (12.5%) had cleft palate, and 124 (62%) had both cleft lip and palate. Unilateral cleft lip was seen in 40 (78%) and bilateral cleft lip in 11 (22%) cases. Unilateral cleft palate was seen in 19 (76%) and bilateral cleft palate in 6 (24%) cases.

A total of 112 (56%) children were below the age of 5 years, of which 69.6% were malnourished (χ^2=16, significant). As per the IAP classification, 39.7%, 30.8%, 20.5%, and 9% of children had Grade 1, 2, 3, and 4 PEM, respectively (Table 1). As per the WHO classification, 12.5% of children had SAM and 34.8% had MAM.

In our study, only 26.5% of children were breastfed, and with increasing severity of the defect, percentage of breastfeeding decreased (χ^2=3.37, p=0.18) as shown in Table 2. More children were breastfed in isolated cleft lip group than isolated cleft palate group, but it was not statistically significant (χ^2=1.28, p=0.25). Breastfeeding practice was strikingly less when both the defects were present together and this was statistically significant (χ^2=9.05, p=0.002). Only 11 (18%) children with unilateral cleft lip and palate were breastfed and 6% of children with bilateral cleft lip and cleft palate (the most severe defect) were breastfed. This suggests that breastfeeding is possible with any severity of defect.

Malnutrition was classified on the basis of IAP, as per which malnutrition was more common in children who were deprived of

Table 1: Weight and height centiles of children (5–15 years) as per IAP growth chart

Centiles	n=88 (%)	Z score	n=88 (%)	Z score
Above 50th centile	31 (35.2)	6.92, S	33 (37.5)	7.27, S
Between 50th and 25th centile	12 (13.6)	3.73, S	3 (3.4)	1.76, NS
Between 25th and 10th centile	11 (12.5)	3.55, S	18 (20.5)	4.76, S
Between 10th and 3rd centile	18 (20.5)	4.76, S	13 (14.8)	3.91, S
Below 3rd centile	16 (18.2)	4.42, S	21 (23.8)	5.25, S

IAP: Indian Academy of Pediatrics

breast milk (χ^2=22.61, significant). Severe form of malnutrition (Grade 3 and 4) was significantly more common in non-breastfed children (χ^2=15.69) as shown in Table 3.

On screening with TDSC, the delay was more common in cleft palate as compared to cleft lip; however, it was not statistically significant (χ^2=0.90, p=0.34). Delay was more common when both the defects were present together as compared to isolated defects (χ^2=0.26, p=0.60). Unilateral defects had more development delays as compared to bilateral defects, and it was statistically significant overall (χ^2=9.44, p=0.002) and even in each category of defect as shown in Table 4.

In children <2 years of age, the maximum developmental delay was found when both the defects present unilaterally (40%) as shown in Table 5. Gross motor and language delay were most common followed by global and personal social and none had isolated fine motor delay. Gross motor delay was most common when both the defects were present together (χ^2=3.61, p=0.30). All the children with global delay were syndromic. Most of the children who had gross motor delay were suffering from severe form of malnutrition. Delay was more common in unilateral defects as compared to bilateral defects.

In children between 2 and 6 years of age, the maximum developmental delays were present in unilateral cleft palate category followed by both defects present unilaterally (Table 6). Gross motor delay was the most common (50%) type and none had isolated fine motor delay. Unilateral defects had more of developmental delay than bilateral defect, and this was statistically significant (χ^2=7.32, p=0.006).

Only 25 (12.5%) children were syndromic (Table 7). Pierre Robin sequence was the most common syndrome (20%) followed by Goldenhar syndrome (16%) and Van der Woude syndrome. Most of the syndromic children (64%) had global developmental delay (χ^2=7.84 significant). Low family income, Recurrent respiratory infections, Repeated hospitalization, congenital heart disease, poor parental education and syndromes were significantly affecting nutritional status (Table 8).

The analysis of the school performance of the schoolgoing children was assessed. Academic performance was taken as percentage of marks in last term ending examination. It was graded as poor if <60%, good >60–70%, very good >70–90%, and outstanding >90%. If the marks card was not available, then parents were verbally enquired about the result. In our study, it showed that only 23% of children had poor school performance.

Table 2: Correlation of severity of defect and breastfeeding

Type of defect	Severity of defect (%)	Breastfed n=53 (%)	Non-breastfed n=147 (%)
Cleft lip	(U)=40 (20)	24 (60)	16 (40)
	(B)=11 (5.5)	4 (36.4)	7 (63.6)
Cleft palate	(U)=19 (9.5)	6 (31.6)	13 (69.4)
	(B)=6 (3)	2 (33.3)	4 (66.7)
Both	(U)=61 (30.5)	11 (18)	50 (82)
	(B)=63 (31.5)	6 (9.5)	57 (90.5)
	Total (n=200)	53 (26.5)	147 (73.5)

DISCUSSION

The positive correlation between severity of defect and poor growth can be attributed to feeding problems associated with severe defect because when we correlated breastfeeding practice with severity

Table 3: Breastfeeding and malnutrition in children 5 years of age (n=78)

Breastfed and malnourished n=18 (%)			Non-breastfed and malnourished n=60 (%)		
Grade 1+2	Grade 3+4	Total	Grade 1+2	Grade 3+4	Total
16 (84.2)	2 (15.8)	18 (23.1)	39 (65)	21 (35)	60 (76.9)

Table 4: Development screening in children <2 years by TDSC

Category	Developmental delay n=15 (23.8)	Normal n=48 (76.2)	p
Cleft lip (n=16)			
Unilateral (n=12)	2 (13.3%)	10 (86.7%)	(χ^2=13.9, *P*=0.002)
Bilateral (n=4)	0 (0%)	4 (100%)	
Cleft palate (n=9)			
Unilateral (n=6)	4 (26.7%)	2 (73.3%)	(χ^2=14.17, *P*=0.002)
Bilateral (n=3)	1 (6.7%)	2 (93.3%)	
Both (n=38)			
Unilateral (n=21)	6 (40%)	15 (60%)	(χ^2=18.71, *P*<0.0001)
Bilateral (n=17)	2 (13.3%)	15 (86.7%)	
Total unilateral n=39 (61.9%)	12 (30.8%)	27 (69.2%)	
Total bilateral			
n=24 (38.1%)	3 (12.5%)	21 (87.5%)	
Grand total			
n=63	15 (23.8%)	48 (76.2%)	

TDSC: Trivandrum development screening chart

Table 5: Development delay in children <2 years by DDST II

Category	Gross motor n=5 (%)	Language n=5 (%)	Fine motor n=0 (%)	Personal social n=1 (%)	Global n=4 (%)
Cleft lip (n=2)		1 (20%)		1 (100%)	
Unilateral (n=2)					
Bilateral (n=0)					
Cleft palate (n=5)	2 (40)	1 (20)			1 (25)
Unilateral (n=4)		1 (20)			
Bilateral (n=1)					
Both (n=8)	3 (60)				
Unilateral (n=6)		2 (40)			1 (25)
Bilateral (n=2)					2 (50)
Total 15	5 (33.33)	5 (33.3)	0 (0)	1 (6.7)	4 (26.7)

DDST II: Denver developmental screening test II

Table 6: Development in the age group of 2–6 years by DDST II

Category	Normal	Delay	Gross motor	Language	Fine motor	Social	Global
Cleft lip (n=13)							
U/l n=11 (%)	7 (63.6)	4 (36.4)	3 (75)				1 (25)
B/l n=2 (%)	1 (50)	1 (50)		1 (100)			
Cleft palate (n=7)							
U/l n=6 (%)	3 (50)	3 (50)	1 (33.3)				2 (66.7)
B/l n=1 (%)	1 (100)	0 (0)					
Both (n=32)							
U/l n=14 (%)	8 (57.1)	6 (42.9)	2 (33.3)	2 (33.3)		1 (16.7)	1 (16.7)
B/l n=18 (%)	14 (77.8)	4 (22.2)	3 (75)	1 (25)			
Total U/l n=31 (%)	18 (58.1)	13 (41.9)	6 (46.2)	2 (15.4)	0	1 (7.7)	4 (30.8)
Total B/l n=21 (%)	16 (76.2)	5 (23.8)	3 (60)	2 (40)	0	0 (0)	0 (0)
Grand total n=52 (%)	34 (65.4)	18 (34.6)	9 (50)	4 (22.2)	0	1 (5.6)	4 (22.2)

Table 7: Syndromic subjects and their developmental status

Syndrome	n=25	Development
Pierre robin sequence	5 (20)	Language delay=4, global delay=1
Goldenhar syndrome	4 (16)	All global delay
Van der Woude syndrome	4 (16)	Language delay=3, global delay=1
Stickler syndrome	1 (4)	Global delay
Patau syndrome	1 (4)	Global delay
Treacher collins syndrome	1 (4)	Language delay
DiGeorge syndrome	1 (4)	Global delay
Acrocallosal syndrome	1 (4)	Global delay
Otopalatodigital syndrome	1 (4)	Global delay
EEC syndrome	1 (4)	Global delay
Peters plus syndrome	1 (4)	Global delay
Spondyloepiphyseal dysplasia congenita	1 (4)	Gross motor delay
Robinow syndrome	1 (4)	Global delay
Unidentified	2 (8)	Both global delays

EEC: Ectrodactyly, ectodermal dysplasia, clefting

Table 8: Factors affecting nutritional status (other than severity of defect and feeding pattern)

Factors	n=70 (%)	Z-value	p-value
Low family income	20 (28.6)	5.29	Significant
Recurrent respiratory infections	15 (21.4)	4.37	Significant
Repeated hospitalization	12 (17.1)	3.81	Significant
Congenital heart disease	9 (12.9)	3.21	Significant
Poor parental education	8 (11.4)	3.01	Significant
Syndromes	6 (8.6)	2.56	Significant

of defect, we found that in our study only 26.5% of the children were breastfed. Among the breastfed children, direct breastfeeding was practiced in only 11%, whereas remaining 15.5% received expressed breast milk. The practice of breastfeeding is significantly less in children with this defect as compared to normal children. As per NFHS 3, 46% of children in India are exclusively breastfed up to 6 months [14]. We observed that as the severity of defect increases, the practice of breastfeeding comes down. Similar results were found in the study conducted by Montagnoli *et al*. [15]. They reported that breastfeeding was more frequent in the isolated cleft lip group (45.9%) than in the isolated cleft palate (12.1%) or cleft lip + palate group (10.5%) [15]. According to Reilly *et al*., babies with a cleft lip are more likely to breastfeed than those with a cleft lip or cleft palate [16]. Garcez and Giugliani found that the breastfeeding duration was significantly higher in the presence of isolated cleft lip, being equal or even superior to (in the case of exclusive breastfeeding) the median of Porto Alegre's general population [17].

To prove that breastfeeding in these children prevents malnutrition even if they had severe form of defect, we divided

the malnourished children into two groups, breastfed and non-breastfed. Malnutrition was strikingly more common in the non-breastfed group. We also observed that severe malnutrition was significantly more common in non-breastfed group. A study conducted in Manchester by Glenny *et al*. also reported the efficacy of breastfeeding in preventing growth lag in children with cleft lip and cleft palate [18]. Clarren *et al*. also reported that breastfeeding is the ideal mode of feeding for children with cleft lip [19]. When we studied the growth status of children 5 years and plotted the anthropometric parameters on IAP growth chart, we found that only 35.2% of children had weight at or above 50th centile and 18.2% of children were falling below 3rd centile. As far as the height was concerned, 23.8% were below 3rd centile indicating linear growth in these children is more affected which also indicates chronicity of poor nutrition. On comparison of nutritional status in children 5 years, it appears that the prevalence of malnutrition comes down as the age advances maybe because children get used to their defect and are able to eat better.

As far as the development of these children is concerned, several studies show that these children score within the low average to average range on clinician-administered measures of mental and motor development assessment. Some studies have also reported that children with this deformity have abnormal brain structure, and it might be due to potentially abnormal brain development. The fact that the pattern of brain abnormalities in children with this defect is dramatically different from the pattern of brain abnormalities seen in adults with this defect suggests that brain growth and development trajectory are also abnormal [20]. However, according to Strauss and Broder, the children with clefts and no other anomalies are not at an increased risk for developmental problems [21]. In their study, they found that almost half of the cases (46.3%) of developmental delay or mental delay were syndromic or had other associated congenital malformations [21,22]. Taking these studies into account, we assessed the development of these children in all the four domains of development.

Maximum number of developmental delay was found in the category of both defects present unilaterally in both the age groups (0–2 years and 2–6 years), and this was statistically significant in both. Even unilateral isolated defects were more commonly associated with delay. According to Tollefson and Sykes, unilateral clefts were associated with underlying brain deformity [23]. Collet and Speltz also found that children with unilateral clefts lag behind in development [24]. In the present study, developmental delay was more common in isolated cleft palate than isolated cleft lip. Similar finding was reported by Kapp-Simon and Krueckeberg [25], Starr *et al*. [26], and Mc Williams *et al*. [27].

Roitman and Laron reported that children with cleft palate and especially those combined with an additional midline cleft lip may be part of holoprosencephaly complex [28]. When we assessed development in individual domains by DDST II, we concluded that gross motor development was affected to the maximum extent, followed by language, global, and personal social. All those who had global delay were syndromic and most with motor delay had severe form of malnutrition, which can also contribute to developmental delay. While assessing language, we labeled a child as a delay only if both receptive and expressive speech were affected as expressive speech is affected in most of these children due to local defect and they can be falsely labeled as a case of language delay. In the age group 6 years, delay was more common in isolated cleft palate than both defects present together, maybe because by this age a large number of severe defects get operated and hence are not brought to the hospital.

Problems such as poor socioeconomic status, poor parental education, recurrent respiratory infections, and hospitalization increase the probability and severity of malnutrition. Our results reinforce that all children with this deformity should be screened for growth lag and developmental delay. If delay is detected, parents must be carefully informed and should be encouraged to maintain their interest in child's needs and to focus on stimulating activities. For the child to maximize his potential, it is important that he or she receives early stimulation.

CONCLUSION

This study proves that it is possible to breastfeed a child with any severity of cleft lip and palate. However, these children are prone to malnutrition as well as developmental delay. Delay was more common in syndromic children and in those with unilateral defect, but factors such as malnutrition, recurrent respiratory infections, and repeated hospitalization also added to the developmental delay. School performance was good in majority of the children.

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