CHAPTER 2

Prevalence of Cleft Lip & Palate in the state of Andhra Pradesh, South India

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Objective: To assess the incidence of cleft lip and palate defects in the state of Andhra Pradesh, South India.

Design Setting: The study was conducted in 2001 in the state of Andhra Pradesh, South India. Andhra Pradesh has a population of 76 million. Three districts, Cuddapah, Medak and Krishna, were identified for this study owing to their diversity: they were urban, semi urban and rural respectively. Literacy rates and consanguinity of the parents was elicited and was compared to national averages to find correlations to cleft births. Type and side of cleft were recorded to compare with other studies around the world and other parts of India.

Results: The birth rate of clefts was found to be 1.09 for every 1000 live births. This study found that 65% of the children born with clefts were males. The distribution of the type of cleft showed 33% had CL, 64% had CLP, 2% had CP and 1% had craniofacial clefts. Unilateral cleft lips were found in 79% of the patients. Of the unilateral cleft lips 64% were left sided. There was a significant correlation of children with clefts being born to parents who shared a consanguineous relationship and those who were illiterate with the Odds Ratio between 5.25 and 7.21 for consanguinity and between 1.55 and 5.85 for illiteracy respectively.

Conclusion: The birth rate of cleft was found to be comparable with other Asian studies, but lower than found in other studies in Caucasian populations and higher than in African populations. The incidence was found to be similar to other studies done in other parts of India. The distribution over the various types of cleft was comparable to that found in other studies.

Oral-facial clefts, particularly cleft lip with (CLP) or without cleft pa cleft palate only (CP) are a major public health problem affecting 1 in 1000 births worldwide[1,2]. A child is born with a cleft somewhere in th 2 minutes according to a WHO study published in 2000[3]. In India alon of infants born every year with CLP is 28,600, which means 78 affecte born every day, or 3 infants with clefts born every hour[4]..

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STUDY DESIGN

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INTRODUCTION

Oral-facial clefts, particularly cleft lip with (CLP) or without cleft palate (CL) and cleft palate only (CP) are a major public health problem affecting 1 in every 500 to 1000 births worldwide[1,2]. A child is born with a cleft somewhere in the world every 2 minutes according to a WHO study published in 2000[3]. In India alone the number of infants born every year with CLP is 28,600, which means 78 affected infants are born every day, or 3 infants with clefts born every hour[4]..

India is the second most populated country in the world with a population of 1.02 billion[5]. For its administration it is divided into 28 states and 7 union territories. Each state is governed by an elected local government, while the union territories are governed by the Government of India directly through its representatives. Andhra Pradesh state is in the south of India.

The purpose of this study was to find out the prevalence of cleft lip and palate in Andhra Pradesh. This study was carried out by a high volume center in the state of Andhra Pradesh in association with the Government of Andhra Pradesh. The reason for the government's involvement with this project was to find out its impact on the health delivery system so that effective treatment could be given.

STUDY DESIGN

Andhra Pradesh has a population of 76 million and is divided into 23 districts. Hyderabad is its capital city. The districts that were chosen for this study were Cuddapah, Medak and Krishna. They were chosen for their socio economical diversity.

Cuddapah district is a predominantly rural district that is drought prone and underdeveloped with the lowest per capita income in the state. The population has very little access to health care.

Medak is a semi-urban district. It is also an arid district but the population here has access to good health care because of its proximity to Hyderabad.

Krishna district has the highest per capita income after the capital Hyderabad. It is an urban district where the population can afford health care.

This study was conducted in 2001. The survey was conducted in collaboration with the administrative head of each district, known as the District Collector or Magistrate, through a unique program called the 'Janmabhoomi Program'. During this program the government did a detailed health survey of each of the three districts Cuddapah, Medak and Krishna, where a medical questionnaire was filled in by each resident of the village/town. Cleft defects were included in the questionnaire in the form of one question which was 'do you know anyone in your village/neighbourhood that has a facial defect?'. If the answer was yes, then the local Primary Health Worker would identify the person with the cleft defect and investigate whether the cleft was a CL, CLP or CP. If the cleft was a CL or CLP then the side of the cleft would be noted. The parents' literacy and consanguinity would be noted.

Simultaneously, data was also collected through the District Medical and Health Officer (DMHO) and the District Education Officer (DEO). The DMHO obtained information of all clefts born or reported through primary health workers who are at primary health centers, which are established in every three villages and in every town. The DEO obtained the information through schools, which are established in every village and town. All the data recorded was entered into a database for further correlation.

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The age at the time of the survey and sex of the affected child were a
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Consanguinity is a widely practiced ritual in Andhra Pradesh. Marriages up to one degree of separation were taken to be a consanguineous relationship i.e. between a girl and her maternal uncle or the between the girl and her maternal uncle's son or her fraternal aunt's son. Therefore consanguinity was noted of the parents to establish a correlation between the two if any.

The age at the time of the survey and sex of the affected child were also noted. The age at the time of the survey was noted so that all children below 1 year of age could be counted towards the live births in the district for that year.

To estimate the prevalence of clefts based on gender, parents' literacy and consanguinity, background variables with a known distribution in the general population was needed. National census information for gender and literacy was available. To obtain the background variables for consanguinity a small cross-section study was undertaken (N=100) in each of the three districts.

RESULTS

The population, distance from Hyderabad and literacy rates of Andhra Pradesh and the three districts are given in Table 1.

	Andhra Pradesh	Cuddapah District	Medak District	Krishna District
Population	76,210,007	2,573,480	2,662,290	4,218,410
Distance from Hyderabad (km)		300	50	250
Literacy rate (%)	61.11	64.02	53.24	69.91

Table 1. Demographic information on state and district level

The number of patients with cleft defects in the three districts were in Cuddapah 556, in Medak 490 and in Krishna 376. The age at the time of the survey and sex of the patients are given in Table 2. There was a male predominance for the cleft defects in all the districts under study. (Table 2)

	Age at the time of survey			Sex	
	<1 year	1-16 years	>16 years	Male (%)	Female (%)
Cuddapah District	75	390	91	405 (73.1)	151 (26.9)
Medak District	57	345	88	313 (63.8)	177 (36.2)
Krishna District	71	241	64	218 (58.1)	158 (42.5)

Table 2. Number, age and sex of patients with cleft defects in three districts of Andhra Pradesh

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Literacy rates of the parents of affected patients showed that the Krishna District statistically had the highest literacy rates as compared to the other districts (Table 3).

	Consanguinity of parents		Education levels of the parents				
	Consan-guineous	Non-Consan-guineous	No Education (%)	Primary School (%)	High School (%)	Graduate (%)	Post Graduate (%)
Cuddapah District	324	232	698 (76.7)	171 (18.8)	25 (2.8)	14 (1.5)	2 (0.2)
Medak District	243	247	573 (63.5)	262 (29.1)	46 (5.1)	18 (2.0)	3 (0.3)
Krishna District	155	221	292 (40.1)	251 (34.5)	151 (20.7)	24 (3.3)	10 (1.4)

Table 3. Consanguinity and education levels of parents with cleft affected offspring in three districts of Andhra Pradesh (number and percentage)

With regard to consanguineous marriages Cuddapah had the highest percentage within the patient group compared to the other two districts (Table 3)

There was a high incidence of Cleft Lip and Palate (CLP) in all three districts followed by Cleft Lip (CL). The incidence of Isolated Cleft Palate was very low. (Table 4)

	Cuddapah District (%)	Medak District (%)	Krishna District (%)
Isolated cleft lip	167 (30)	156 (32)	139 (37)
Cleft lip and Palate	368 (66)	319 (65)	226(60)
Unilateral	*422 (79)*	*370 (78)*	*292 (80)*
Left	*262 (62)*	*244 (66)*	*184 (63)*
Right	*160 (38)*	*126 (33)*	*108 (37)*
Bilateral	*113 (21)*	*105(22)*	*73 (20)*
Isolated cleft palate	16 (3)	12 (2)	9 (2)
Craniofacial cleft	5 (1)	3 (1)	2 (1)

Table 4. Type and side of cleft per district (number and percentage)

There was a higher prevalence of unilateral clefts than of bilateral clefts. In unilateral clefts there was a higher prevalence of left sided clefts as compared to right sided ones (Table 4).

We calculated the prevalence of clefts in each district by registering the total number of live births in each district in 2001 and dividing it by the number of children who had clefts and were under 1 year in the same district. The prevalence for the state of Andhra Pradesh was calculated by defining the average of the prevalence of the three districts. The number of live births in Andhra Pradesh State during the same period was 1,666,000 (Census of India 2001). Assuming the prevalence in the state at 1.09 in 1000 live births, 1,830 children were born with cleft defects in the state of Andhra Pradesh in 2001 (Table 5).

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	Cuddapah District	Medak District	Krishna District	Andhra Pradesh State
Live Births	65,562	49,504	69,741	184,807
Cleft Defects	75	57	71	203
Incidence	1.14 in 1000 live births	1.15 in 1000 live births	1.01 in 1000 live births	1.09 in 1000 live births

Table 5. Incidence of clefts per district.

The relation between prevalence of clefts and background variables was also calculated. For gender, the national census information shows that the ratio of males to females is 1000:993 (Census of India 2001). This information regards the national ratio as information on a district level is not available. For literacy rates, using an education level of primary school or higher as a definition of "literate", the percentages for the districts were Cuddapah 64.5%, Medak 53.2% and Krishna 69.9% (Census of India 2001). For consanguinity the prevalence in a small cross sectional study of 100 couples in each of the three districts was Cuddapah 21%, Medak 12% and Krishna 9%. To convert the percentages into absolute numbers for the background variables for gender and literacy it was arbitrarily chosen to be 1000.

The odds ratio for a child being born with a cleft in relation with gender is 2.50, 1.65 and 1.29 for the districts of Cuddapah, Medak and Krishna respectively. With regard to parents' illiteracy the odds ratio's are 5.85 for Cuddapah, 1.98 for Medak and 1.55 for Krishna. Consanguinity is 5.25, 7.21 and 7.09 for the three districts respectively. All 9 odds ratio's are statistically significantly above 1, as can be seen from the 95% confidence intervals (Table 6).

	Cuddapah District		*Medak District*		*Krishna District*	
	Case	Ctrl	Case	Ctrl	Case	Ctrl
Gender						
Male	405	517	313	517	218	517
Female	151	483	177	483	158	483
Odds Ratio	2.50		1.65		1.29	
95% CI for OR	[1.99 - 15]		[1.32 - 2.07]		[1.01 - 1.64]	
Literacy						
Yes	698	360	573	468	291	301
No	212	640	329	532	437	699
Odds Ratio	5.85		1.98		1.55	
95% CI for OR	[4.77 - 7.18]		[1.64 - 2.39]		[1.26 - 1.90]	
Consanguinity						
Yes	232	790	247	880	221	910
No	324	210	243	120	155	90
Odds Ratio	5.25		7.21		7.09	
95% CI for OR	[4.17 - 6.62]		[5.53 - 9.41]		[5.23 - 9.62]	

Table 6. Relation between clefts and gender, literacy and consanguinity per district.

DISCUSSION

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DISCUSSION

This study was conducted in 2001. The reason for a delay in publishing these findings is that the study of prevalence of clefts was part of a much larger program. This program was a state wide development program where the Government of Andhra Pradesh was reaching out to 80 million people of the state. The districts involved with this study have a population in excess of 9.45 million. Since most of the data, including the data the Government of Andhra Pradesh was collecting, was being collected for the first time, sorting out and collating the data took time.

There are also some drawbacks to a study of this size. Firstly, the study had to be simplified such that very few questions had to be asked by the interviewers as other programs were being jointly run by the government. Secondly, the staff interviewing the subjects were not trained doctors and therefore could only be trained to identify a cleft and a detailed report on conditions that might have contributed to the cleft could not be included in the study.

While calculating the prevalence of cleft based on the data collected, it was agreed that those children that were less than one year of age would be included in the census as a simultaneous census to see the total number of live births in that region was concurrently going on. We do accept that there might be misrepresentation of children that might have died during the year. However, we accepted this method because registry for births and deaths is not very accurately maintained in large parts of rural areas of the state.

A review of studies for prevalence of cleft lip and palate shows that there is a particular trend in different parts of the world. A WHO study published as Global Strategies to Reduce the Health Care Burden of Craniofacial Anomalies in 2000 details the prevalence in 13 countries and the prevalence varies from 0.22 to 1.67 per 1000 live births[3].

Birth prevalence and incidence of oral-facial clefting show ethnic variation. It is generally thought that populations of Asian or Native North American descent have the highest prevalence, with Caucasian populations having intermediate prevalence and African populations having the lowest prevalence[6]. In studies conducted on Caucasian population, the prevalence of clefts in Northern Ireland was found to be 1.28 for every 1000 live birth[7]. The prevalence of cleft defects in Stockholm County in Sweden was found to be 2.0:1000 live birth[8]. In studies conducted in Latin American population, a study in Northeast Mexico showed a prevalence of clefts to be 1.1:1000 live birth[9], while a study carried out in an African population in Nigeria showed a birth rate of cleft anomalies at 0.4:1000 live birth[10].In Asia, a study of a Han Chinese population in Shanghai, China[11] showed a prevalence of 1.12 per 1000 live births. A study of a native Filipino population reported that the prevalence was higher at 1.54 in 1000 live births[12]. A study in Iran showed an prevalence of 1.03:1000 live birth[13]. Our study showed a prevalence of 1.09 in 1000 live births. In India meta-analysis of 25 early studies from 1960 to 1979 involving 407,025 births showed 440 births with CLP and 25 births with CP with a prevalence of 1.08 and 0.23 in 100 live births respectively[4].

Most studies, including ours, report a male predominance in the sex ratio in cleft lip and palate patients and a female predominance in patients with cleft palate defects only[14,15,16]. However one district in our study showed an unusually high male predominance for clefts. This discrepancy needs to be further investigated for any extraneous circumstances. Male predominance for cleft lip and palate was also confirmed by the odds ratio which determined that there was a greater possibility of a male child being born with a cleft lip and palate.

Most studies give a ratio between unilateral and bilateral cleft lips to be predominantly favouring unilateral cleft lips[15,17,18]. We found 79% of the cleft lip defects were unilateral in nature. It is also widely accepted that left sided unilateral

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clefts are more common than right sided unilateral cleft lips[10,14] which is supported by this study. Of the unilateral cleft lips in our study 64% were left sided.

The type and extent of cleft defects vary according to race. In a study published on a Caucasian cleft population the prevalence of CL was 25%, CLP 50%, and 25%CP[19]. A study on an African cleft population, done in Nigeria, showed prevalence to be CL 49%, CLP 32% and 19% CP[10]. Our study showed a prevalence of CL to be 33%, CLP 64 %, and CP 3%. The reason for the low percentage of CP could be due to under reporting of the problem. CP may be undiagnosed at birth and could have been missed in the evaluation of patients.

As stated earlier consanguinity is a widely practiced ritual in Andhra Pradesh. Our study shows that consanguinity of parents is a major risk factor for cleft formation. This study highlights the regressive nature of this practice.

We found a significant differentiation in cleft birth rates between urban and rural areas which are in contrast with the Chinese study[16]. We found a strong correlation between illiteracy and clefts in our study. We also found that illiteracy rates were higher in rural areas in the state. We feel, and this was confirmed by the study, that poorer sections of society are more likely to be illiterate and the odds ratio of a cleft being born to illiterate parents is considerably higher. Additionally it should be noted that a relation between illiteracy and consanguinity is likely, with a higher percentages of consanguinity in illiterate populations. Therefore, a part of the relation between illiteracy and cleft birth rates might be due to confounding between illiteracy and consanguinity. Data to check this is currently not available. This implies that the relation between illiteracy and cleft birth rate needs further study to assess its true size and understand the biological mechanism.

CONCLUSION

Our study showed a prevalence of 1.09 in 1000 live births, which was significantly less than the Caucasian and Filipino population studies and significantly higher than the African population study. It was however comparable to other Asian studies like those done in China, Iran and particularly India. It was also comparable to a study done in Mexico.

Three different districts of Andhra Pradesh were chosen to represent the state. This design could be used in other districts to accurately detect the prevalence of clefts.

Data sources may influence or bias the results. Thus precise documentations of birth and death registry will help to evaluate the true values of prevalence.

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CHAPTER 2

Prevalence of Cleft Lip & Palate in the state of Andhra Pradesh, South India

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Objective: To assess the incidence of cleft lip and palate defects in the state of Andhra Pradesh, South India.

Design Setting: The study was conducted in 2001 in the state of Andhra Pradesh, South India. Andhra Pradesh has a population of 76 million. Three districts, Cuddapah, Medak and Krishna, were identified for this study owing to their diversity: they were urban, semi urban and rural respectively. Literacy rates and consanguinity of the parents was elicited and was compared to national averages to find correlations to cleft births. Type and side of cleft were recorded to compare with other studies around the world and other parts of India.

Results: The birth rate of clefts was found to be 1.09 for every 1000 live births. This study found that 65% of the children born with clefts were males. The distribution of the type of cleft showed 33% had CL, 64% had CLP, 2% had CP and 1% had craniofacial clefts. Unilateral cleft lips were found in 79% of the patients. Of the unilateral cleft lips 64% were left sided. There was a significant correlation of children with clefts being born to parents who shared a consanguineous relationship and those who were illiterate with the Odds Ratio between 5.25 and 7.21 for consanguinity and between 1.55 and 5.85 for illiteracy respectively.

Conclusion: The birth rate of cleft was found to be comparable with other Asian studies, but lower than found in other studies in Caucasian populations and higher than in African populations. The incidence was found to be similar to other studies done in other parts of India. The distribution over the various types of cleft was comparable to that found in other studies.

Oral-facial clefts, particularly cleft lip with (CLP) or without cleft pa cleft palate only (CP) are a major public health problem affecting 1 in 1000 births worldwide[1,2]. A child is born with a cleft somewhere in th 2 minutes according to a WHO study published in 2000[3]. In India alon of infants born every year with CLP is 28,600, which means 78 affecte born every day, or 3 infants with clefts born every hour[4]..

India is the second most populated country in the world with a popu billion[5]. For its administration it is divided into 28 states and 7 unic Each state is governed by an elected local government, while the uni are governed by the Government of India directly through its re Andhra Pradesh state is in the south of India.

The purpose of this study was to find out the prevalence of cleft lip Andhra Pradesh. This study was carried out by a high volume center i Andhra Pradesh in association with the Government of Andhra Prades for the government's involvement with this project was to find out the health delivery system so that effective treatment could be given.

STUDY DESIGN

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INTRODUCTION

Oral-facial clefts, particularly cleft lip with (CLP) or without cleft palate (CL) and cleft palate only (CP) are a major public health problem affecting 1 in every 500 to 1000 births worldwide[1,2]. A child is born with a cleft somewhere in the world every 2 minutes according to a WHO study published in 2000[3]. In India alone the number of infants born every year with CLP is 28,600, which means 78 affected infants are born every day, or 3 infants with clefts born every hour[4]..

India is the second most populated country in the world with a population of 1.02 billion[5]. For its administration it is divided into 28 states and 7 union territories. Each state is governed by an elected local government, while the union territories are governed by the Government of India directly through its representatives. Andhra Pradesh state is in the south of India.

The purpose of this study was to find out the prevalence of cleft lip and palate in Andhra Pradesh. This study was carried out by a high volume center in the state of Andhra Pradesh in association with the Government of Andhra Pradesh. The reason for the government's involvement with this project was to find out its impact on the health delivery system so that effective treatment could be given.

STUDY DESIGN

Andhra Pradesh has a population of 76 million and is divided into 23 districts. Hyderabad is its capital city. The districts that were chosen for this study were Cuddapah, Medak and Krishna. They were chosen for their socio economical diversity.

Cuddapah district is a predominantly rural district that is drought prone and underdeveloped with the lowest per capita income in the state. The population has very little access to health care.
Medak is a semi-urban district. It is also an arid district but the population here has access to good health care because of its proximity to Hyderabad.
Krishna district has the highest per capita income after the capital Hyderabad. It is an urban district where the population can afford health care.

This study was conducted in 2001. The survey was conducted in collaboration with the administrative head of each district, known as the District Collector or Magistrate, through a unique program called the 'Janmabhoomi Program'. During this program the government did a detailed health survey of each of the three districts Cuddapah, Medak and Krishna, where a medical questionnaire was filled in by each resident of the village/town. Cleft defects were included in the questionnaire in the form of one question which was 'do you know anyone in your village/neighbourhood that has a facial defect?'. If the answer was yes, then the local Primary Health Worker would identify the person with the cleft defect and investigate whether the cleft was a CL, CLP or CP. If the cleft was a CL or CLP then the side of the cleft would be noted. The parents' literacy and consanguinity would be noted.

Simultaneously, data was also collected through the District Medical and Health Officer (DMHO) and the District Education Officer (DEO). The DMHO obtained information of all clefts born or reported through primary health workers who are at primary health centers, which are established in every three villages and in every town. The DEO obtained the information through schools, which are established in every village and town. All the data recorded was entered into a database for further correlation.

The literacy rates of the parents were used as a marker because it is v
obtain the exact per capita income of parents of children born wit
living in rural areas, who depend on agriculture for their earnings.
India is seasonal and yearly income fluctuates from year to year an
accurate reading for income is not readily available. The literacy of
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hypothetical and not exact.

Consanguinity is a widely practiced ritual in Andhra Pradesh. Marri
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a girl and her maternal uncle or the between the girl and her mater
or her fraternal aunt's son. Therefore consanguinity was noted of
establish a correlation between the two if any.

The age at the time of the survey and sex of the affected child were
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could be counted towards the live births in the district for that year.
To estimate the prevalence of clefts based on gender, parent
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The literacy rates of the parents were used as a marker because it is very difficult to obtain the exact per capita income of parents of children born with cleft defects living in rural areas, who depend on agriculture for their earnings. Agriculture in India is seasonal and yearly income fluctuates from year to year and therefore an accurate reading for income is not readily available. The literacy of a person was thought to correspond better to the socio-economic status of that person. Income from agriculture in India is exempt from income tax and people completely dependent on agriculture do not need to file the details of their income. This means that all government data on income in the rural areas of India are hypothetical and not exact.

Consanguinity is a widely practiced ritual in Andhra Pradesh. Marriages up to one degree of separation were taken to be a consanguineous relationship i.e. between a girl and her maternal uncle or the between the girl and her maternal uncle's son or her fraternal aunt's son. Therefore consanguinity was noted of the parents to establish a correlation between the two if any.

The age at the time of the survey and sex of the affected child were also noted. The age at the time of the survey was noted so that all children below 1 year of age could be counted towards the live births in the district for that year.

To estimate the prevalence of clefts based on gender, parents' literacy and consanguinity, background variables with a known distribution in the general population was needed. National census information for gender and literacy was available. To obtain the background variables for consanguinity a small cross-section study was undertaken (N=100) in each of the three districts.

RESULTS

The population, distance from Hyderabad and literacy rates of Andhra Pradesh and the three districts are given in Table 1.

	Andhra Pradesh	Cuddapah District	Medak District	Krishna District
Population	76,210,007	2,573,480	2,662,290	4,218,410
Distance from Hyderabad (km)		300	50	250
Literacy rate (%)	61.11	64.02	53.24	69.91

Table 1. Demographic information on state and district level

The number of patients with cleft defects in the three districts were in Cuddapah 556, in Medak 490 and in Krishna 376. The age at the time of the survey and sex of the patients are given in Table 2. There was a male predominance for the cleft defects in all the districts under study. (Table 2)

	Age at the time of survey			Sex	
	<1 year	1-16 years	>16 years	Male (%)	Female (%)
Cuddapah District	75	390	91	405 (73.1)	151 (26.9)
Medak District	57	345	88	313 (63.8)	177 (36.2)
Krishna District	71	241	64	218 (58.1)	158 (42.5)

Table 2. Number, age and sex of patients with cleft defects in three districts of Andhra Pradesh

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Literacy rates of the parents of affected patients showed that the Krishna District statistically had the highest literacy rates as compared to the other districts (Table 3).

	Consanguinity of parents		Education levels of the parents				
	Consan-guineous	Non-Consan-guineous	No Education (%)	Primary School (%)	High School (%)	Graduate (%)	Post Graduate (%)
Cuddapah District	324	232	698 (76.7)	171 (18.8)	25 (2.8)	14 (1.5)	2 (0.2)
Medak District	243	247	573 (63.5)	262 (29.1)	46 (5.1)	18 (2.0)	3 (0.3)
Krishna District	155	221	292 (40.1)	251 (34.5)	151 (20.7)	24 (3.3)	10 (1.4)

Table 3. Consanguinity and education levels of parents with cleft affected offspring in three districts of Andhra Pradesh (number and percentage)

With regard to consanguineous marriages Cuddapah had the highest percentage within the patient group compared to the other two districts (Table 3)

There was a high incidence of Cleft Lip and Palate (CLP) in all three districts followed by Cleft Lip (CL). The incidence of Isolated Cleft Palate was very low. (Table 4)

	Cuddapah District (%)	Medak District (%)	Krishna District (%)
Isolated cleft lip	167 (30)	156 (32)	139 (37)
Cleft lip and Palate	368 (66)	319 (65)	226(60)
Unilateral	*422 (79)*	*370 (78)*	*292 (80)*
Left	*262 (62)*	*244 (66)*	*184 (63)*
Right	*160 (38)*	*126 (33)*	*108 (37)*
Bilateral	*113 (21)*	*105(22)*	*73 (20)*
Isolated cleft palate	16 (3)	12 (2)	9 (2)
Craniofacial cleft	5 (1)	3 (1)	2 (1)

Table 4. Type and side of cleft per district (number and percentage)

There was a higher prevalence of unilateral clefts than of bilateral clefts. In unilateral clefts there was a higher prevalence of left sided clefts as compared to right sided ones (Table 4).

We calculated the prevalence of clefts in each district by registering the total number of live births in each district in 2001 and dividing it by the number of children who had clefts and were under 1 year in the same district. The prevalence for the state of Andhra Pradesh was calculated by defining the average of the prevalence of the three districts. The number of live births in Andhra Pradesh State during the same period was 1,666,000 (Census of India 2001). Assuming the prevalence in the state at 1.09 in 1000 live births, 1,830 children were born with cleft defects in the state of Andhra Pradesh in 2001 (Table 5).

	Cuddapah District (%)	Medak District (%)	Krishna District (%)
lip	167 (30)	156 (32)	139 (37)
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palate	16 (3)	12 (2)	9 (2)
cleft	5 (1)	3 (1)	2 (1)

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	Cuddapah District	Medak District	Krishna District	Andhra Pradesh State
Live Births	65,562	49,504	69,741	184,807
Cleft Defects	75	57	71	203
Incidence	1.14 in 1000 live births	1.15 in 1000 live births	1.01 in 1000 live births	1.09 in 1000 live births

Table 5. Incidence of clefts per district.

The relation between prevalence of clefts and background variables was also calculated. For gender, the national census information shows that the ratio of males to females is 1000:993 (Census of India 2001). This information regards the national ratio as information on a district level is not available. For literacy rates, using an education level of primary school or higher as a definition of "literate", the percentages for the districts were Cuddapah 64.5%, Medak 53.2% and Krishna 69.9% (Census of India 2001). For consanguinity the prevalence in a small cross sectional study of 100 couples in each of the three districts was Cuddapah 21%, Medak 12% and Krishna 9%. To convert the percentages into absolute numbers for the background variables for gender and literacy it was arbitrarily chosen to be 1000.

The odds ratio for a child being born with a cleft in relation with gender is 2.50, 1.65 and 1.29 for the districts of Cuddapah, Medak and Krishna respectively. With regard to parents' illiteracy the odds ratio's are 5.85 for Cuddapah, 1.98 for Medak and 1.55 for Krishna. Consanguinity is 5.25, 7.21 and 7.09 for the three districts respectively. All 9 odds ratio's are statistically significantly above 1, as can be seen from the 95% confidence intervals (Table 6).

	Cuddapah District		*Medak District*		*Krishna District*	
	Case	Ctrl	Case	Ctrl	Case	Ctrl
Gender						
Male	405	517	313	517	218	517
Female	151	483	177	483	158	483
Odds Ratio	2.50		1.65		1.29	
95% CI for OR	[1.99 - 15]		[1.32 - 2.07]		[1.01 - 1.64]	
Literacy						
Yes	698	360	573	468	291	301
No	212	640	329	532	437	699
Odds Ratio	5.85		1.98		1.55	
95% CI for OR	[4.77 - 7.18]		[1.64 - 2.39]		[1.26 - 1.90]	
Consanguinity						
Yes	232	790	247	880	221	910
No	324	210	243	120	155	90
Odds Ratio	5.25		7.21		7.09	
95% CI for OR	[4.17 - 6.62]		[5.53 - 9.41]		[5.23 - 9.62]	

Table 6. Relation between clefts and gender, literacy and consanguinity per district.

DISCUSSION

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DISCUSSION

This study was conducted in 2001. The reason for a delay in publishing these findings is that the study of prevalence of clefts was part of a much larger program. This program was a state wide development program where the Government of Andhra Pradesh was reaching out to 80 million people of the state. The districts involved with this study have a population in excess of 9.45 million. Since most of the data, including the data the Government of Andhra Pradesh was collecting, was being collected for the first time, sorting out and collating the data took time.

There are also some drawbacks to a study of this size. Firstly, the study had to be simplified such that very few questions had to be asked by the interviewers as other programs were being jointly run by the government. Secondly, the staff interviewing the subjects were not trained doctors and therefore could only be trained to identify a cleft and a detailed report on conditions that might have contributed to the cleft could not be included in the study.

While calculating the prevalence of cleft based on the data collected, it was agreed that those children that were less than one year of age would be included in the census as a simultaneous census to see the total number of live births in that region was concurrently going on. We do accept that there might be misrepresentation of children that might have died during the year. However, we accepted this method because registry for births and deaths is not very accurately maintained in large parts of rural areas of the state.

A review of studies for prevalence of cleft lip and palate shows that there is a particular trend in different parts of the world. A WHO study published as Global Strategies to Reduce the Health Care Burden of Craniofacial Anomalies in 2000 details the prevalence in 13 countries and the prevalence varies from 0.22 to 1.67 per 1000 live births[3].

Birth prevalence and incidence of oral-facial clefting show ethnic variation. It is generally thought that populations of Asian or Native North American descent have the highest prevalence, with Caucasian populations having intermediate prevalence and African populations having the lowest prevalence[6]. In studies conducted on Caucasian population, the prevalence of clefts in Northern Ireland was found to be 1.28 for every 1000 live birth[7]. The prevalence of cleft defects in Stockholm County in Sweden was found to be 2.0:1000 live birth[8]. In studies conducted in Latin American population, a study in Northeast Mexico showed a prevalence of clefts to be 1.1:1000 live birth[9], while a study carried out in an African population in Nigeria showed a birth rate of cleft anomalies at 0.4:1000 live birth[10].In Asia, a study of a Han Chinese population in Shanghai, China[11] showed a prevalence of 1.12 per 1000 live births. A study of a native Filipino population reported that the prevalence was higher at 1.54 in 1000 live births[12]. A study in Iran showed an prevalence of 1.03:1000 live birth[13]. Our study showed a prevalence of 1.09 in 1000 live births. In India meta-analysis of 25 early studies from 1960 to 1979 involving 407,025 births showed 440 births with CLP and 25 births with CP with a prevalence of 1.08 and 0.23 in 100 live births respectively[4].

Most studies, including ours, report a male predominance in the sex ratio in cleft lip and palate patients and a female predominance in patients with cleft palate defects only[14,15,16]. However one district in our study showed an unusually high male predominance for clefts. This discrepancy needs to be further investigated for any extraneous circumstances. Male predominance for cleft lip and palate was also confirmed by the odds ratio which determined that there was a greater possibility of a male child being born with a cleft lip and palate.

Most studies give a ratio between unilateral and bilateral cleft lips to be predominantly favouring unilateral cleft lips[15,17,18]. We found 79% of the cleft lip defects were unilateral in nature. It is also widely accepted that left sided unilateral

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clefts are more common than right sided unilateral cleft lips[10,14] which is supported by this study. Of the unilateral cleft lips in our study 64% were left sided.

The type and extent of cleft defects vary according to race. In a study published on a Caucasian cleft population the prevalence of CL was 25%, CLP 50%, and 25%CP[19]. A study on an African cleft population, done in Nigeria, showed prevalence to be CL 49%, CLP 32% and 19% CP[10]. Our study showed a prevalence of CL to be 33%, CLP 64 %, and CP 3%. The reason for the low percentage of CP could be due to under reporting of the problem. CP may be undiagnosed at birth and could have been missed in the evaluation of patients.

As stated earlier consanguinity is a widely practiced ritual in Andhra Pradesh. Our study shows that consanguinity of parents is a major risk factor for cleft formation. This study highlights the regressive nature of this practice.

We found a significant differentiation in cleft birth rates between urban and rural areas which are in contrast with the Chinese study[16]. We found a strong correlation between illiteracy and clefts in our study. We also found that illiteracy rates were higher in rural areas in the state. We feel, and this was confirmed by the study, that poorer sections of society are more likely to be illiterate and the odds ratio of a cleft being born to illiterate parents is considerably higher. Additionally it should be noted that a relation between illiteracy and consanguinity is likely, with a higher percentages of consanguinity in illiterate populations. Therefore, a part of the relation between illiteracy and cleft birth rates might be due to confounding between illiteracy and consanguinity. Data to check this is currently not available. This implies that the relation between illiteracy and cleft birth rate needs further study to assess its true size and understand the biological mechanism.

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CONCLUSION

Our study showed a prevalence of 1.09 in 1000 live births, which was significantly less than the Caucasian and Filipino population studies and significantly higher than the African population study. It was however comparable to other Asian studies like those done in China, Iran and particularly India. It was also comparable to a study done in Mexico.

Three different districts of Andhra Pradesh were chosen to represent the state. This design could be used in other districts to accurately detect the prevalence of clefts.

Data sources may influence or bias the results. Thus precise documentations of birth and death registry will help to evaluate the true values of prevalence.

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Prevalence of Cleft Lip and Palate in the state of Andhra Pradesh, South India

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Objective:

To assess the incidence prevalence of cleft lip and palate defects in the state of Andhra Pradesh, South India.

Design Setting:

The study was conducted in 2001 in the state of Andhra Pradesh, South India. Andhra Pradesh has a population of 76 million. Three districts, Cuddapah, Medak and Krishna, were identified for this study owing to their diversity. They were urban, semi urban and rural respectively. Literacy rates and consanguinity of the parents was elicited and was compared to national averages to find correlations to cleft births. Type and side of cleft were recorded to compare with other studies around the world and other parts of India.

Results:

The birth rate of clefts was found to be 1.09 for every 1000 live births. This study found that 65% of the children born with clefts were males. The distribution of the type of cleft showed 33% had CL, 64% had CLP, 2% had CP and 1% had craniofacial clefts. Unilateral cleft lips were found in 79% of the patients. Of the unilateral cleft lips 64% were left sided. There was a significant correlation of children with clefts being born to parents who shared a consanguineous relationship and those who were illiterate with the Odds Ratio between 5.25 and 7.09 for consanguinity and between 1.55 and 5.85 for illiteracy respectively.

Conclusion:

The birth rate of cleft was found to be comparable with other Asian study, but lower than found in other studies in Caucasian populations and higher than in African populations. The prevalence was found to be similar to other studies done in other parts of India. The distribution over the various types of cleft was comparable to that found in other studies.

Key Words:

IncidencePrevalence, Cleft, Lip, Palate, Andhra Pradesh, India

Introduction:

Oral-facial clefts, particularly cleft lip with (CLP) or without cleft palate (CL/P) and cleft palate alone (CP) are a major public health problem affecting 1 in every 500 to 1000 births worldwide (Cooper ME et al 2000; Murray JC, 2002;). A child is born with a cleft somewhere in the world every 2 minutes according to a WHO study published in 2001(World Health Organization 2001). In India alone the number of infants born every year with CLP is 28,600, which means 78 affected infants are born every day, or 3 infants with clefts born every hour In India alone it is estimated that 32,000 children (1.01:1000 births) are born with clefts every year (Raju, 2001Mossey P et al 2009).

India is the second most populated country in the world with a population of 1.02 billion (Census of India 2001). For its administration it is divided into 28 states and 7 union territories. Each state is governed by an elected local government, while the union territories are governed by the Government of India directly through its representatives. Andhra Pradesh state is in the south of India.

This study was carried out by a high volume center in the state of Andhra Pradesh in association with the Government of Andhra Pradesh. The reason for the government's involvement with this project was to find out its impact on the health delivery system so that effective treatment could be given.

Study design:

Andhra Pradesh has a population of 76 million and is divided into 23 districts. Hyderabad is its capital city.

Three districts were chosen for this study Cuddapah, Medak and Krishna. They were chosen for this study for their socio economical diversity.

Cuddapah district is a predominantly rural district that is drought prone and under developed with the lowest per capita income in the state. The population has very little access to health care.

Medak is a semi-urban district. It is also an arid district but the population here has access to good health care because of its proximity to Hyderabad.

Krishna district has the highest per capita income after the capital Hyderabad. It is an urban district where the population can afford health care.

This study was conducted in 2001. The survey was conducted in collaboration with the administrative head of each district, known as the District Collector or Magistrate, through a unique program called the 'Janmabhoomi Program'.

During this program the government did a detailed health survey of each of the three districts Cuddapah, Medak and Krishna, where a medical questionnaire is filled in by each resident of the village/town. Cleft defects were included in the questionnaire in the form of one question which was, do you know anyone in your village/neighborhood that has a facial defect? If the answer was yes, then the local Primary Health Worker would

identify the person with the cleft defect and investigate whether the cleft was a CL, CLP or CP. If the cleft was a CL or CLP then the side of the cleft would be noted. The parents' literacy and consanguinity would be noted.

Simultaneously, data was also collected through the District Medical and Health Officer (DMHO) and the District Education Officer (DEO). The DMHO obtained information of all clefts born or reported through primary health workers who are there at primary health centers, which are established in every three villages and in every town. The DEO obtained the information through schools, which are established in every village and town. All the data recorded was entered into a database for further correlation.

The literacy rates of the parents were used as a marker because it is very difficult to obtain the exact per capita income of parents of children born with cleft defects living in rural areas, who depend on agriculture for their earnings. Agriculture in India is seasonal and yearly income fluctuates from year to year and therefore an accurate reading for income is not readily available. The literacy of a person was thought to correspond better to the socio economic status of that person. Income from agriculture in India is exempt from income tax in India and people completely dependent on agriculture need not file the details of their income. This means that all government data on income in the rural areas of India are hypothetical and not exact.

Consanguinity is a widely practiced ritual in Andhra Pradesh. Marriages up to one degree of separation were taken to be a consanguineous relationship i.e. between a girl and her

maternal uncle or the between the girl and her maternal uncle's son or her fraternal aunt's son. Therefore consanguinity was noted of the parents to establish a correlation between the two if any.

The age at the time of presentationage at the time of the survey and sex of the affected child were also noted. The age at the time of presentationage at the time of the survey was noted so that all children below 1 year of age could be counted towards the live births in the district for that year. This study was conducted in 2001.

To estimate the prevalence of clefts based on gender, parents' literacy and consanguinity, background variables with a known distribution in the general population was needed. National census information for gender and literacy was available. To obtain the background variables for consanguinity a small cross-section study was undertaken (N=100) in each of the three districts.

Results:

The population, distance from Hyderabad and literacy rates of Andhra Pradesh and the three districts are given in Table 1

The number of patients with cleft defects in the three districts were Cuddapah 556, Medak 490 and Krishna 376. The age at the time of presentationage at the time of the survey and sex of the patient are given in Tables 2 and 3.

There was a male predominance for the cleft defects in all the districts under study. (Table 3Table 2)

Literacy rates of the parents of affected patients showed that Krishna District statistically had the highest literacy rates as compared to the other districts (Table 43).

With regard to consanguineous marriages Cuddapah had the highest percentage within the patient group compared to the other two districts (Table 35)

There was a high incidence of Cleft Lip and Palate (CLP) in all three districts followed by Cleft Lip (CL). The incidence of Isolated Cleft Palate was very low. (Table 64)

There was a higher prevalence of unilateral clefts to bilateral clefts. In unilateral clefts there was a higher prevalence of left sided clefts as compared to right sided ones. (Table 64)

We calculated the incidenceprevalence of clefts in each district by registering the total number of live births in each district in 2001 and dividing it by the number of children who had clefts and were under 1 year in the same district.

The incidenceprevalence for the state of Andhra Pradesh was calculated by defining the average of the incidenceprevalence of the three districts. The number of live births in Andhra Pradesh State during the same period was 1,666,000 (Census of India 2001). Assuming the incidenceprevalence in the state at 1.09 in 1000 live births, 1,830 children were born with cleft defects in the state of Andhra Pradesh in 2001 (Table 5).

The relation between incidenceprevalence of clefts and background variables was also calculated. For gender, the national census information shows that the ratio of males to females is 1000:993 (Census of India 2001). This information regards the national ratio as information on a district level is not available. For literacy rates, using an education level of primary school or higher as a definition of "literate", the percentages for the districts were Cuddapah 64.5%, Medak 53.2% and Krishna 69.9% (Census of India 2001). For Consanguinity the prevalence in a small cross sectional study of 100 couples in each of the three districts was Cuddapah 21%, Medak 12% and Krishna 9%. To

convert the percentages into absolute numbers for the background variables for gender and literacy it was arbitrarily chosen to be 1000.

The odds ratio for a child being born with a cleft in relation with gender is 2.50, 1.65 and 1.29 for the districts of Cuddapah, Medak and Krishna respectively. With regard to parents' illiteracy the odds ratio's are 5.85 for Cuddapah, 1.98 for Medak and 1.55 for Krishna. Consanguinity is 5.25, 7.21 and 7.09 for the three districts respectively. All 9 odds ratio's are statistically significantly above 1, as can be seen from the 95% confidence intervals (Table 6).

Discussion:

This study was conducted in 2001. The reason for a delay in publishing these findings is that the study of prevalence of clefts was part of a much larger program. This program was a state wide development program where the Government of Andhra Pradesh was reaching out to 80 million people of the state. The districts involved with this study have a population in excess of 9.45 million. Since most of the data, including the data the Government of Andhra Pradesh was collecting was being done for the first time, sorting out and collating the data took time.

There are also some drawbacks to a study of this size. Firstly, the study had to be simplified such that very few questions had to be asked by the interviewers as other programs were being jointly run by the government. Secondly the staff interviewing the subjects were not trained doctors and therefore could only be trained to identify a cleft and a detailed report on conditions that might have contributed to the cleft could not be included in the study.

While calculating the prevalence of cleft based on the data collected, it was agreed that those children that were less than one year of age would be included in the census as a simultaneous census to see the total number of live births in that region was concurrently going on. We do accept that there might be misrepresentation of children that might have died during the year, we accepted this method because registry for births and deaths is not very accurately maintained in large parts of rural areas of the state.

A review of studies of for incidenceprevalence of cleft lip and palate shows that there is no particular trend in different parts of the world. A WHO study published as Global Strategies to Reduce the Health Care Burden of Craniofacial Anomalies in 2000 details

the incidenceprevalence in 13 countries and the incidenceprevalence varies from 0.22 to 1.67 per 1000 live births.

Birth prevalence and incidence of oral-facial clefting show ethnic variation. It is generally thought that populations of Asian or Native North American descent have the highest prevalence, with Caucasian populations having intermediate prevalence and African populations having the lowest prevalence (Gorlin et. al. 2001).

In studies conducted on Caucasian population, the incidenceprevalence of clefts in Northern Ireland was found to be 1.28 for every 1000 live births (Gregg et al 1994). The incidenceprevalence of cleft defects in Stockholm County in Sweden was found to be 2.0:1000 live births (Hagberg et. al. 1998).

In studies conducted in Latin American population, a study in Northeast Mexico showed an incidenceprevalence of clefts to be 1.1:1000 live births (Blanco-Davilla, 2003), while a study carried out in an African population in Nigeria showed a birth rate of cleft anomalies at 0.4:1000 live births (Iregbulem, 1982).

In Asia, a study of a Han Chinese population in Shanghai, China (Cooper et. al, 2000) showed a prevalence of 1.12 per 1000 live births. A study of a native Filipino population reported that the prevalence was higher at 1.54 in 1000 live births (Murray et. al. 1997). A study in Iran showed an incidenceprevalence of 1.03:1000 live births (Rajabian 2000). Our study showed an incidenceprevalence of 1.09 in 1000 live births. In India meta-

analysis of 25 early studies from 1960 to 1979 involving 407,025 births showed 440 births with CLP and 25 births with CP with a prevalence of 1.08 and 0.23 in 100 live births respectively (Mossey P et al 2009).

Most studies, including ours, report a male predominance in the sex ratio in cleft lip and palate patients and a female predominance in patients with cleft palate defects alone (Fogh-Anderson, 1971; Abyholm, 1978; Wu, 1995). However one district in our study showed an unusually high male predominance for clefts. This discrepancy needs to be further investigated for any extraneous circumstances. Male predominance for cleft lip and palate was also confirmed by the odds ratio which determined that there was a greater possibility of a male child being born with a cleft lip and palate.

Most studies give a ratio between unilateral and bilateral cleft lips to be predominantly favoring unilateral cleft lips (Abyholm FE,1978; Womersley J, 1987; Jensen.BL,et al 1988) We found 79% of the cleft lip defects were unilateral in nature. It is also widely accepted that left sided unilateral clefts are more common than right sided unilateral cleft lips (Fogh-Anderson, 1971; Iregbulem LM,1982) which is supported by this study. Of the unilateral cleft lips in our study 64% of were left sided.

The type and extent of cleft defects vary according to race. In study published on a Caucasian population the incidenceprevalence of CL was 25%, CLP 50%, and CP 25% (Croen LA 1998). A study on an African population, done in Nigeria showed incidenceprevalence to be CL 49%, CLP 32% and CP 19% (Iregbulem, 1982).. Our study

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As stated earlier consanguinity is a widely practiced ritual in Andhra Pradesh. Our study shows that consanguinity of parents is a major risk factor for cleft formation. This study highlights the regressive nature of this practice.

We found a significant differentiation in cleft birth rates between urban and rural areas which are in contrast with the Chinese study (Wu Y, Zeng M, 1995). We found a strong correlation between illiteracy and clefts in our study. We also found that illiteracy rates were higher in rural areas in the state. We feel, and this was confirmed by the study, that poorer sections of society are more likely to be illiterate and the odds ratio of a cleft being born to illiterate parents is considerably higher. Malnutrition could also be a possible cause of clefts in undernourished parents of a cleft child. Additionally it should be noted that a relation between illiteracy and consanguinity is likely, with a higher percentages of consanguinity in illiterate populations. Therefore, a part of the relation between illiteracy and cleft birth rates might be due to confounding between illiteracy and consanguinity. Data to check this is currently not available. This implies that the relation between illiteracy and cleft birth rate needs more study to assess its true size and understand the biological mechanism.

Conclusion:

Our study showed an a incidenceprevalence of 1.09 in 1000 live births, which was significantly less than the Caucasian and Filipino population studies and significantly higher than the African population study. It was however comparable to other Asian studies like those done in China and Iran. It was also comparable to study done in Mexico.

Three diverse districts of Andhra Pradesh were chosen to represent the state. This exercise could be used in other districts to accurately find the prevalence of clefts.

Data sources may influence or bias the results. Thus precise documentations of birth and death registry will help evaluate the true values of incidenceprevalence.

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