

Oral Health Status and Treatment Needs of Iruligas at Ramanagara District, Karnataka, India

S Kadanakuppe¹, PK Bhat²

ABSTRACT

Objectives: To assess the oral health status and treatment needs of Iruliga tribal community residing at Ramanagara District, Karnataka, India.

Methods: The total population of 2605 Iruligas residing at 26 villages of Ramanagara District was included for the study. Data were collected using World Health Organization (WHO) 1997 'Oral Health Assessment Form'. Examination was done under good natural light using a mouth mirror and community periodontal index (CPI) probe.

Results: The total study population was 2605, comprising 1545 males and 1060 females in the age group of 1–80 years with the mean age of 30.56 ± 19.51 . The majority of Iruligas (79.8%) used chew sticks as an oral hygiene aid. Subjects with leukoplakia were found to be 3 (0.12). The most commonly seen enamel opacity/hypoplasia was diffuse opacity affecting 930 (35.7%) subjects. A mild form of dental fluorosis affected 1658 (63.65%) subjects. Subjects with bleeding were only 4.22%; subjects with calculus were 57.9%; those with shallow pockets (4–5 mm) were 22.0% and subjects with deep pockets (≥ 6 mm) were 3.67%. The prevalence of dental caries among Iruligas was found to be 7.52%. The mean number of decayed, missing, filled (DMF) permanent teeth per person was 0.55 ± 0.1 . Definite malocclusion, which required elective treatment, was noted in 14.1%. Iruligas with need for referral were found to be 29.94% ($n = 780$) according to the various treatment needs required for different oral diseases.

Conclusion: This study revealed less prevalence of oral diseases among Iruligas, highlighting the role of good oral health practices prevalent among this isolated population.

Keywords: Aboriginal, oral health, tribe

Estado de la Salud Oral y Necesidades de Tratamiento de los Iruligas, en el Distrito de Ramanagara, Karnataka, India

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RESUMEN

Objetivos: Evaluar el estado de salud oral y las necesidades de tratamiento en la comunidad tribal Iruliga, que reside en el Distrito de Ramanagara, Karnataka, India.

Métodos: La población total de 2605 Iruligas que residen en 26 aldeas del Distrito de Ramanagara, fue incluida en el estudio. Los datos fueron recogidos usando el Formulario de evaluación de la salud oral (OMS) de 1997. El examen se hizo bajo buena luz natural, usando un espejo bucal, y la sonda Índice Periodontal Comunitario (IPC).

Resultados: La población total del estudio fue 2605, y abarcó 1545 varones y 1060 hembras en el grupo etario de 1–80 años, con una edad media de 30.56 ± 19.51 . La mayoría de los Iruligas (79.8%) usaban palillos de masticar como medio para la higiene oral. Se halló que los sujetos con leucoplasia oral eran 3 (0.12). La hipoplasia u opacidad del esmalte más común fue la opacidad difusa que afectaba a 930 (35.7%) sujetos. Una forma leve de fluorosis dental afectaba a 1658 (63.65%) de los sujetos. Los sujetos con sangramiento fueron sólo el 4.22%. Los sujetos con cálculo fueron el 57.9%; los que presentaban bolsas poco profundas (4–5 mm) fueron el 22.0% y los sujetos con bolsas profundas (≥ 6 mm) fueron

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el 3.67%. Se halló que la prevalencia de las caries dentales entre los Iruligas fue de 7.52%. El número promedio de dientes permanentes con caries, faltantes y obturados (DMF) fue 0.55 ± 0.1 . La maloclusión definida, que requirió tratamiento electivo, se hizo evidente en 14.1%. Se halló que los Iruligas con necesidad de ser remitidos fue un 29.94% ($n = 780$) de acuerdo con las diferentes necesidades de tratamiento requeridas para las diferentes enfermedades orales.

Conclusión: Este estudio reveló menos prevalencia de enfermedades orales entre los Iruligas, destacando el papel de las buenas prácticas de la salud oral prevalentes entre esta población aislada.

Palabras claves: Aborigen, salud oral, tribu

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INTRODUCTION

The aboriginal populations of India, unevenly distributed throughout the subcontinent, are called 'scheduled tribes' in the Constitution. They form a substantial indigenous minority comprising 8.2% of the total Indian population as per census 2001. Many smaller tribal groups are quite sensitive to ecological degradation caused by modernization. The 'Iruliga' tribal community residing at Ramanagara District, Karnataka, India, is the jungle tribe of the plains, some of them residing on the lower elevations of the hills and in the forest of the plains. A few folkloric research studies have been done on this tribe, which describe the influence of modernization in the past two decades, on their cultural and socio-economic life, but none on their general or oral health status (1–2). It is important to assess and describe their oral health status in light of these changes. Hence this pioneering study aims to assess the oral health status and treatment needs of the 'Iruliga' community, which is transitioning from a hunter-gatherer lifestyle to a more modern lifestyle.

SUBJECT AND METHODS

Since the census report from The Directorate of Census Operation, Karnataka could not provide the population size of this specific tribe, the census conducted on this tribe by a folkloric study was considered (1). Accordingly, it was reported that around 2500 Iruligas reside in Ramanagara, scattered in 26 different villages. Before the start of the study, preliminary visits to the study area were made to ascertain the population size by obtaining information from the village panchayats of the concerned villages along with population enumeration by housing census. The natives belonging to the Iruliga tribe residing at the villages of Ramanagara District who were willing to participate were included. The study obtained approval from the Institutional Review Board.

Data were collected using the World Health Organization (WHO) 1997 'Oral Health Assessment Form' (3). Examination was done under good natural light using a mouth mirror and community periodontal index (CPI) Probe. Boxes 29 and 30 of the WHO oral health assessment form were utilized to collect information regarding oral hygiene practices and habits and the details were collected by personal interview. Before the start of the study, the examiner was standardized and cali-

brated according to guidelines given by WHO oral health surveys, basic methods (3). The intra-examiner reliability was also assessed to ensure consistency (kappa value, $\kappa = 0.86$). Repeated attempts were made to examine those people who were not available at the first attempt of examination.

The source of drinking water was bore well. A sample of drinking water was collected at each examination site (each Iruliga colony in 26 villages) for analysis of fluoride levels. Fluoride analysis was done using UV-spectrophotometry by Zirconium (IV)-Alizarin Red S method.

Chi-square test was used and statistical significance for the study was achieved when $p < 0.05$ with 95% confidence level.

RESULTS

The total study population enumerated and assessed was 2605, comprising 1545 males and 1060 females, age range 1–80 years with the mean age of 30.56 ± 19.51 . The distribution of the total population by occupation showed that 47 (1.80%) practiced only hunting; 2443 (93.8%) worked as coolies as well as carried out hunting occasionally and 115 (4.4%) practiced other occupations like lumbering from their forests.

The usage of oral hygiene aids showed that 2079 (79.8%) Iruligas used chew sticks, whereas 390 (14.9%) of them used the finger with either rangoli powder/salt/charcoal. Only five (0.19%) Iruligas used the finger with either toothpaste or toothpowder. Toothbrush, with either toothpaste or toothpowder, was used by only one (0.03%) Iruliga.

Iruligas used alcohol occasionally [790 (30.32%)]; 281 (10.78%) used smokeless form of tobacco, 245 (9.4%) of them smoked tobacco and 616 (23.64%) Iruligas chewed pan only without tobacco.

Assessment of oral mucosal lesions showed that the number and percentage of subjects with leukoplakia were found to be 3 (0.12%), ulceration 2 (0.08%) and acute necrotizing gingivitis 6 (0.23%).

The most commonly seen enamel opacity/hypoplasia was diffuse opacity, affecting 930 (35.7%) subjects, followed by demarcated opacity and demarcated and diffuse opacity, affecting 884 (33.93%) and 299 (11.48%), respectively (Fig. 1). The number and percentage of Iruligas with dental fluorosis, by level of severity, indicated that 1658 (63.65%) subjects were

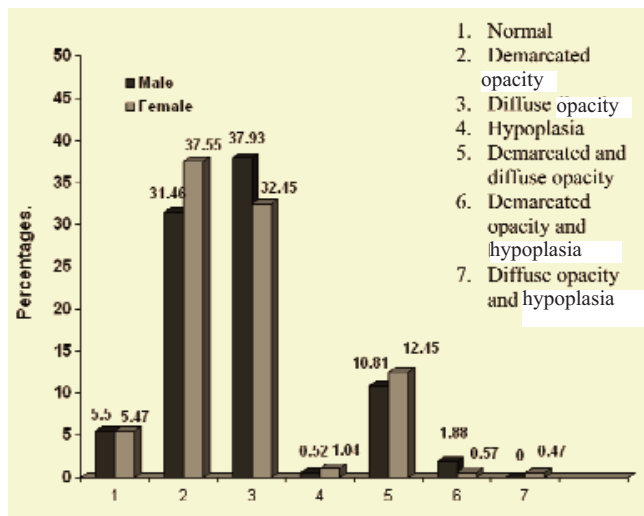


Fig. 1: Prevalence of enamel opacities/hypoplasia among the Iruliga population.

affected with a mild form of dental fluorosis, followed by questionable, 262 (10.06%), very mild, 67 (2.57%) and moderate, 11 (0.42%).

The fluoride levels assessed in all 26 villages was in the range of 1 ppm to 2.85 ppm. The dental fluorosis in all the five villages with fluoride level less than 1.5 ppm compared to that of other villages with fluoride levels above 1.5 ppm was significantly less. Questionable, mild and very mild forms of dental fluorosis were seen in 29.3%, 28.2% and 0.6% in below optimum villages compared to 5.7%, 71.4% and 2.9%, respectively for the rest of the villages above optimum, which were statistically significant ($p < 0.001$) [Table 1].

Table 1: Association of fluoride levels in water samples at Iruliga settlements with the prevalence of dental fluorosis

| Dental fluorosis | Fluoride levels [#] | | | | Combined | | p-value |
|------------------|------------------------------|--------------|----------------------------|--------------|-------------|---------------|----------|
| | Below optimum [‡] | | Above optimum [§] | | | | |
| | n | % | n | % | n | % | |
| Normal | 141 | 30.1 | 156 | 7.3 | 297 | 11.40 | < 0.001* |
| Questionable | 137 | 29.3 | 123 | 5.7 | 262 | 10.06 | < 0.001* |
| Very mild | 3 | 0.6 | 64 | 2.9 | 67 | 2.57 | < 0.05* |
| Mild | 132 | 28.2 | 1526 | 71.4 | 1658 | 63.65 | < 0.001* |
| Moderate | 0 | – | 11 | 0.5 | 11 | 0.42 | – |
| Severe | 0 | – | 2 | 0.09 | 2 | 0.08 | – |
| Excluded | 21 | 4.6 | 112 | 5.2 | 133 | 5.11 | – |
| Not recorded | 34 | 7.2 | 138 | 6.5 | 172 | 6.71 | – |
| Total | 468 | 100.0 | 2137 | 100.0 | 2605 | 100.00 | – |

[#] Fluoride levels in drinking water at Iruliga settlements.

[‡] Fluoride levels < 1.5 ppm

[§] Fluoride levels > 1.5 ppm

* Statistically significant

Figure 2 and Table 2 show percentage and mean number of sextants of Iruligas with periodontal disease conditions as indicated by the community periodontal index. Subjects with bleeding were only 4.22% (0.38 ± 1.11), subjects with calcu-

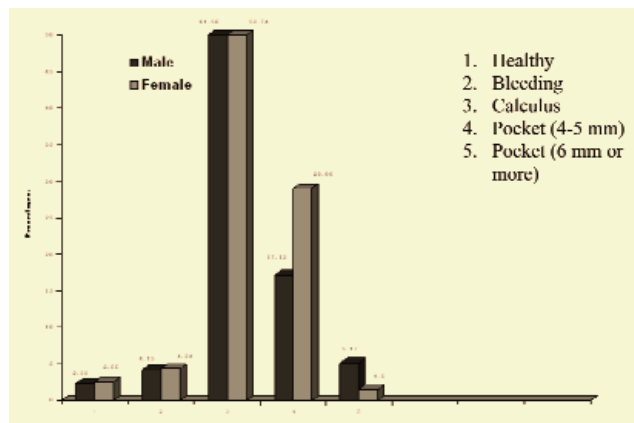


Fig. 2: Prevalence of periodontal disease conditions using community periodontal index (CPI).

Table 2: Mean number of sextants affected with periodontal disease conditions.

| CPI | Mean number of sextants |
|---|-------------------------|
| Healthy | 0.14 ± 0.68 |
| Bleeding | 0.38 ± 1.11 |
| Calculus | 3.87 ± 2.44 |
| Pocket (4–5 mm) | 0.79 ± 1.50 |
| Pocket (6 mm or more) | 0.06 ± 0.35 |
| Mean number of sextants excluded from examination | 0.48 ± 0.79. |

CPI: community periodontal index

lus were 57.9% (3.87 ± 2.44), subjects with shallow pockets (4–5 mm) were 22.0% (0.79 ± 1.50), and subjects with deep pockets (≥ 6 mm) were 3.67% (0.06 ± 0.35). Tables 3 and 4 show

the percentage and mean number of sextants of Iruligas with loss of attachment. Tables 5 and 6 show correlation of age with prevalence of periodontal disease conditions and loss of attachment, respectively.

Table 3: Prevalence of loss of attachment by gender

| Loss of attachment | Male | | Female | | Combined | |
|--------------------|-------------|---------------|-------------|---------------|-------------|---------------|
| | n | % | n | % | n | % |
| 0–3 mm | 909 | 58.83 | 585 | 55.19 | 1494 | 57.35 |
| 4–5 mm | 263 | 17.02 | 311 | 29.34 | 574 | 22.03 |
| 6–8 mm | 89 | 5.79 | 12 | 1.13 | 101 | 3.88 |
| 9–11 mm | 1 | 0.04 | – | – | 1 | 0.04 |
| 12 mm or more | – | – | – | – | – | – |
| Not recorded | 283 | 18.32 | 152 | 14.34 | 435 | 16.70 |
| Total | 1545 | 100.00 | 1060 | 100.00 | 2605 | 100.00 |

Table 4: Mean number of sextants for loss of attachment

| Loss of attachment | Mean number of sextants |
|--------------------|-------------------------|
| 0–3 mm | 4.12 ± 2.44 |
| 4–5 mm | 0.79 ± 1.49 |
| 6–8 mm | 0.08 ± 0.47 |
| 9–11 mm | 0.001 ± 0.02 |
| 12 mm or more | – |

Table 5: Correlation of age with the prevalence of periodontal disease conditions

| Age (years) | Persons examined (n) | Healthy | | Bleeding | | Calculus | | Pocket (4–5 mm) | | Pocket (6 mm or more) | |
|-------------|----------------------|---------|------|----------|------|----------|------|-----------------|------|-----------------------|-----|
| | | n | % | n | % | n | % | n | % | n | % |
| < 5 | – | – | – | – | – | – | – | – | – | – | – |
| 6–12 | 172 | 29 | 16.9 | 65 | 37.8 | 78 | 45.3 | – | – | – | – |
| 13–15 | 227 | – | – | 4 | 1.8 | 223 | 98.2 | – | – | – | – |
| 16–34 | 747 | – | – | 8 | 1.1 | 640 | 85.7 | 59 | 7.9 | 40 | 5.4 |
| 35–44 | 555 | – | – | – | – | 400 | 72.1 | 128 | 23.1 | 27 | 4.9 |
| 45–64 | 381 | – | – | – | – | 169 | 44.4 | 199 | 52.2 | 13 | 3.4 |
| 65–74 | 180 | – | – | – | – | – | 0.0 | 166 | 78.2 | 14 | 7.8 |
| ≥ 75 | 23 | – | – | – | – | – | 0.0 | 21 | 91.3 | 2 | 8.7 |

Table 6: Correlation of age with the prevalence of loss of attachment

| Age (years) | Persons examined (n) | 0–3 mm | | 4–5 mm | | 6–8 mm | | 9–11 mm | | ≥ 12 mm | |
|-------------|----------------------|--------|-------|--------|------|--------|------|---------|-----|---------|---|
| | | n | % | n | % | n | % | n | % | n | % |
| < 5 | – | – | – | – | – | – | – | – | – | – | – |
| 6–14 | – | – | – | – | – | – | – | – | – | – | – |
| 15 | 76 | 74 | 97.36 | 2 | 2.63 | – | – | – | – | – | – |
| 16–34 | 747 | 647 | 86.6 | 60 | 8.0 | 40 | 5.35 | – | – | – | – |
| 35–44 | 555 | 394 | 71.0 | 125 | 22.5 | 36 | 6.49 | – | – | – | – |
| 45–64 | 381 | 173 | 45.4 | 195 | 51.2 | 13 | 3.41 | – | – | – | – |
| 65–74 | 180 | – | 0.0 | 170 | 94.4 | 10 | 5.56 | 1 | 0.5 | – | – |
| ≥ 75 | 23 | – | 0.0 | 21 | 91.3 | 2 | 8.70 | – | – | – | – |

The prevalence of dental caries among Iruligas (Table 7) was found to be 7.52% (n = 196). The mean number of decayed and missing permanent teeth per person was 0.82 ± 0.8 and 0.56 ± 1.2 , respectively. The mean number of decayed and missing deciduous teeth per person was 1.62 ± 0.2 and 0.98 ± 1.2 , respectively. Filled teeth were not found among Iruligas. The mean number of decayed, missing, filled (DMF) permanent teeth per person was 0.55 ± 0.1 and the percentage of Iruligas with four or more DMF teeth was 3.84. The mean number of DMF primary teeth per person was 0.98 ± 2.8 and the percentage of subjects with four or more primary teeth was 4.54%.

The prevalence of root caries among Iruligas was found in the age groups of 45–64, 65–74 and ≥ 75 years with 1.30%

Table 7: Prevalence of dental caries by age

| Age (years) | Persons examined (n) | Prevalence of caries | |
|--------------|----------------------|----------------------|-------------|
| | | n | % |
| < 5 | 253 | 25 | 9.88 |
| 6–12 | 191 | 12 | 6.28 |
| 13–15 | 229 | 34 | 14.8 |
| 16–34 | 747 | 45 | 6.02 |
| 35–44 | 555 | 24 | 4.32 |
| 45–64 | 383 | 24 | 6.26 |
| 65–74 | 192 | 21 | 10.93 |
| ≥ 75 | 55 | 8 | 14.54 |
| Total | 2605 | 196 | 7.52 |

(n = 5), 5.20% (n = 10), and 14.54% (n = 8), respectively. The mean number of teeth per person with root caries in the same age groups was found to be 0.01 ± 0.7 , 0.05 ± 1.1 and 0.14 ± 0.23 , respectively. It was found that 6.26% (n = 24), 10.93% (n = 21), and 14.54% (n = 8) of Iruligas in the age groups of 45–64, 65–74, and ≥ 75 years, respectively had coronal and/or root caries. The mean number of teeth per person with coronal and/root caries in the same age groups were 0.06 ± 1.1 , 0.10 ± 0.6 , and 0.14 ± 0.23 , respectively. Treatment needs among Iruligas as shown in Fig. 3 indicates that only 8.86%

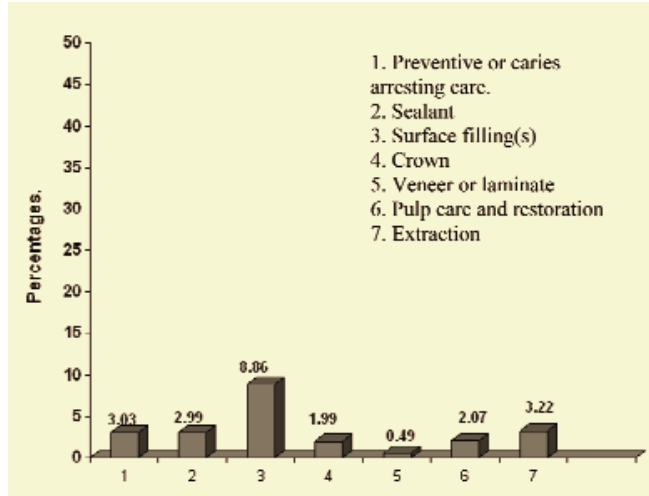


Fig. 3: Percentage distribution of treatment needs.

(mean number of teeth = 0.61 ± 1.2) needed surface fillings and 3.22% (mean number of teeth = 0.34 ± 0.9) needed extraction of teeth.

Number and percentage of Iruligas with prosthesis, by type of prosthesis and by jaw show that only 2 (0.08%) subjects had partial denture in the upper jaw. Table 8 shows num-

Table 8: Percentage of subjects with prosthetic need

| Prosthetic need | Upper | | Lower | |
|--|-------------|--------------|-------------|--------------|
| | n | % | n | % |
| No prostheses needed | 2412 | 92.6 | 2418 | 92.8 |
| Need for one unit prosthesis | 31 | 1.2 | 25 | 0.9 |
| Need for multi-unit prosthesis | 12 | 0.5 | 2 | 0.8 |
| Need for combination of one and/or multi-unit prosthesis | 9 | 0.3 | 44 | 1.7 |
| Need for full prosthesis | 96 | 3.7 | 71 | 2.7 |
| Not recorded | 45 | 1.7 | 45 | 1.7 |
| Total | 2605 | 100.0 | 2605 | 100.0 |

ber and percentage of Iruligas requiring prosthesis, by type of prosthesis and by jaw. Only 96 (3.7%) and 71 (2.7%) Iruligas needed full prosthesis in the upper and the lower jaw, respectively.

Table 9 shows the prevalence of dentofacial anomalies among Iruligas. The severity of malocclusion within the

Table 9: Prevalence of dentofacial anomalies among Iruliga population

| Dentofacial anomalies | Number (n = 1913) | % |
|--|-------------------|------|
| Missing incisor, canine, premolar teeth | 27 | 1.4 |
| Crowding in incisal segment | 794 | 41.5 |
| Spacing in the incisal segment | 410 | 21.4 |
| Diastema | 415 | 21.6 |
| Largest anterior maxillary irregularity | 149 | 7.8 |
| Largest anterior mandibular irregularity | 740 | 38.7 |
| Anterior maxillary overjet | 1840 | 96.2 |
| Anterior mandibular overjet | 6 | 0.3 |
| Vertical anterior open bite | 3 | 0.16 |
| Anteroposterior molar relation | 45 | 2.4 |

Iruliga population is classified based on the standard disease activity index (DAI) scores. Accordingly, 71.4% of Iruligas have no abnormality or minor malocclusion, and only 2.8% of Iruligas had very severe or handicapping malocclusion, in whom treatment is mandatory (Fig. 4).

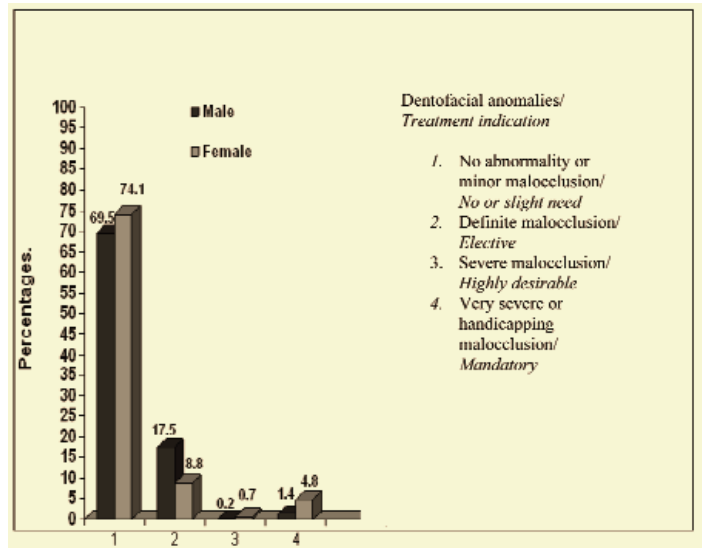


Fig. 4: Prevalence of dentofacial anomalies among Iruliga population by level of severity and treatment indication.

Iruligas with need for referral were found to be 29.94% (n = 780) according to the various treatment needs required for different oral diseases.

DISCUSSION

The influence of modernization on the Iruliga population within the last two decades has slowly forced them from their traditional hunter-gatherer lifestyle to adopt a non-tribal lifestyle (1). Both commercial forestry and intensive agriculture have proved destructive to the Handi-Gundi forests that had endured Iruligas for many centuries. Some of them are still hunters and gatherers who live in isolation in the Handi-Gundi hills and forests of Ramanagara. The phase of transition from hunter-gatherer lifestyle to non-tribal lifestyle of Iruliga aborigines is comparable with Tiwi aboriginals of Australia

(4), American Indian, and Alaska aboriginals (5) even though Iruliga aboriginals have very recently made their way into modernization.

The persistent nature of Iruligas to retain their traditional lifestyle contributes to many of the indigenous health practices, including oral health practices, seen in them. Iruligas (79.8%) use chew sticks made of the twig of the Neem tree (*Azadirachta indica*, which they call “bevon kaddi”) to clean their mouth. The Iruliga folk medicinal practice regards the use of chew sticks to clean the mouth as a good daily practice.

Concerning the prevalence of leukoplakia (0.12%), the present study revealed a relatively low prevalence in comparison with the findings of the study conducted by Ikeda *et al* on Cambodian native people (1.1%) in which it was reported to be significantly associated with smoking (6). Although alcohol use is seen occasionally in Iruligas, they dislike tobacco use due to the bad odour associated with smoking. This relatively low prevalence of tobacco use (20.18% both smoke and smokeless form) among Iruligas could be the factor for less prevalence of oral mucosal lesions. Nonetheless, it clearly depicts the ill effects of tobacco usage.

The prevalence of enamel opacity/hypoplasia was 49.44% in this study, which is low when compared to the 99% reported in the study conducted by Pascoe and Seow of the Tiwi tribes and 98% reported in a study conducted by Seow *et al* on aboriginals of Brisbane, Australia (4, 7). By condition, the prevalence of diffuse opacity was 35.7% (n = 930), followed by demarcated opacity (33.93%, n = 884), both demarcated and diffuse opacity (11.48%, n = 299), and hypoplasia (0.73%, n = 19). These findings are low when compared to the prevalence of enamel opacities and hypoplasia of 78% and 85%, respectively reported by Pascoe and Seow (4). The authors attributed the high prevalence of enamel hypoplasia to the extremely poor general health, which was likely to lead to derangements of enamel formation. The reason for enamel hypoplasia recorded in Iruligas could be due to other possible causes of enamel defects, in addition to factors regarding general health, such as endemic fluorosis as the fluoride analysis of drinking water of the study area revealed fluoride levels between 1.0 and 2.85 ppm.

Drinking water fluoride estimation depicts its correlation with dental fluorosis by level of severity. Five villages of Iruliga settlement had water fluoride level below the cut off point of 1.5 ppm as given by WHO (8). In all those five villages, most of the Iruligas were not found to be affected with fluorosis even though a small portion of them were observed with questionable form of fluorosis. This could be explained by the fact that Iruligas keep migrating from one settlement to the other due to their basic nomadic nature and mainly in search of better occupation in plantations.

Iruligas suffer from various forms of periodontal disease as depicted in Fig. 2, comparable to the findings of the study conducted by Fareed (91.61%) on Soligas in Biligiri Ranga Hills, India and to that of Peterson (91%) on Malagasy tribes in Madagascar (9, 10). This finding is similar to the study con-

ducted by Mosha *et al* for the native Tanzanian population (mean number of sextants = 3.3) and high compared to the findings of the study conducted by Skrepcinski and Niendorff on American Indians and Alaska Natives [mean number of sextants = 1.8] (11–12). Both studies indicated that calculus was the most commonly found condition in all age groups.

The prevalence of pockets was found in those 34 years and above. The prevalence of periodontal pockets (CPI score 3 and 4) among Iruligas was found to be 26.67% which does not agree with the findings of 60.8% (CPI score 3 and 4) of Australian aboriginals in Western Australia by Smith *et al* (13). In the age group of 35–44 years, the prevalence of shallow pockets (4–5 mm) in American Indians and Alaska Natives, reported in a study conducted by Phipps *et al*, was 53.5% (14) and those reported by Skrepcinski and Niendorff was 38.1% [mean number of sextants = 1.7] (12) which was higher when compared to Iruligas (23.1%; mean number of sextants = 0.79 ± 1.50) in the similar age groups. But this was reversed in the age group of 65–74 years as the prevalence of shallow pockets in American Indians and Alaska Natives (30.8%) is much lower than that of Iruligas (78.2%). This decrease in prevalence with age in American Indians and Alaska Natives was explained by the fact that areas with the lowest rates of pocketing were among those that also have the most missing teeth, whereas higher prevalence in the 35–44-year age group is explained by the fact that more teeth have been saved among children and adults by the IHS programme. Periodontal disease will increase as more teeth remain in the mouth longer.

The prevalence of dental caries among Iruligas was found to be 7.52% (n = 196). The mean DMF of Iruligas was 0.55, whereas the percentage of Iruligas with four or more DMF teeth was 3.84%. These findings are comparable to those of the study conducted by Mosha *et al*, which reports that Tanga natives had 1.6% and Mbeya natives had 7.27% of caries prevalence (11). Whereas it is low when compared with a study conducted by William *et al* in which the mean DMFT for Native Americans was reported to be 9.6 (15). The Iruliga children below five years of age had 9.88% of caries prevalence (mean DMFT = 0.98 ± 2.8) which was very low when compared with those of the studies conducted by Seow *et al* for Aboriginal pre-school children of Australia (78%), Malagasy aboriginal five-year old children of Madagascar reported by Peterson (85%) and that reported by Endean *et al* on Anangu aboriginal children of the same age group in the Anangu Pitjantjatjara lands in South Australia [mean 3.20] (7, 10, 16). Native American children in the same age group showed caries prevalence with regional differences ranging from 6% in Aberdeen natives to 30% in Navajo native children (15). Alaskan native children (< 5 years) had mean DMFT of 4.88 as reported by Jones *et al* when compared to 0.98 of Iruliga children below five years of age (17). When compared to 88% and 85% prevalence of dental caries of Wallisians and Melanesian 12-year old native children as reported by Bougeois *et al* (18), Iruliga children in the similar age group had lesser prevalence (14.8%). Filled teeth were not found among Iruli-

gas. The mean number of DMF permanent teeth per person in Iruligas was 0.55, which was less compared to 1.99 among Mbeya natives and 2.38 of Tanga natives and much less when compared to 9.66 among Native Americans (11, 15).

This study indicates the prevalence of caries in children more than in adult Iruligas. The low prevalence rate of dental caries among Iruligas could be explained by several factors. The diet mainly constitutes Ragi and green leaves regularly mixed in form since they hunt small animals like rats, which they eat regularly (1). This diet is not a rich source of carbohydrates. Mainly school-going children of Iruligas have an opportunity to mingle with non-tribal children and outside society and hence have a greater chance of exposure to refined carbohydrates. Between meals, snacking is rarely seen among Iruligas; if present, it is seen in Iruliga children who adapt more rapidly to modernization. The Iruliga population is in the transitional stage, which exposes them, more so the children, to modern civilization and with that the ravages caused by caries. Even though the prevalence rate is less, the increased caries prevalence among Iruliga children indicates the onset of the effects of modernization on oral health. Another important factor to consider is the drinking water source, which was found to be fluoridated (fluoride levels ranged from 1.00–2.85 ppm). The beneficial effects of Neem chew sticks used by the majority of Iruligas should not be overlooked. In a dental health survey in Sudan, Emsile reported for the first time fewer caries in people using chewing sticks than those using toothbrushes (19). Low caries prevalence among chew stick users has been reported despite intake of a carbohydrate-rich diet and lack of modern dental prophylactic measures (20, 21). In general, the Namibian “muthala” users had a relatively low caries rate (22). In a comprehensive survey of several thousands of school children in Zimbabwe, Sathanathan *et al* demonstrated that children who used chew sticks for oral hygiene had fewer carious lesions than children who brushed their teeth with a conventional toothbrush and paste (23). An earlier controlled clinical study by Baghdady and Ghose reported that Sudanese schoolchildren showed lower caries prevalence due to using a miswak, and their diet (24). Similar results were noted in Saudi children aged 13 to 15 years when compared with children in Western countries (25). Again, the main preventive factor reported was miswak use by these children. Hence, it is important to realize its benefits, and in this direction, further research is needed to identify the role of Neem chew stick used by Iruligas in reducing caries.

The treatment needs of Iruligas were low when compared to those of Native Americans (surface fillings = 1.72 mean number of teeth per person, 0.76 for crowns, and 0.63 for extraction), Alaska native, Tanga and Mbeya native people [caries arrest = 1.13%, surface fillings = 16.3%, extractions = 24.6%] (11, 26). The lower treatment needs among Iruligas is due to the lower prevalence of oral diseases.

The prosthetic status of Iruligas indicated that only two (0.08%) subjects had partial denture in the upper jaw. These findings, when compared to the findings of a study conducted

by Phipps *et al* (36.5% needed one unit and 40.0% multi-unit prosthesis) are indicative of low prosthetic needs among Iruligas (14). Iruligas who needed full prosthesis in the upper and the lower jaw were also less ($n = 167$, 6.4%) when compared to Native Americans (55.3%).

Iruligas with 0.4% severe malocclusion required treatment considered highly desirable. Also noted was that 2.8% of Iruligas had handicapping or very severe malocclusion which required mandatory treatment. Genetic factors might have an influence on the characteristics of malocclusion, which should be given consideration when comparing the findings of this study on Iruligas with other aboriginal groups.

About 29.94% of Iruligas were found to have referral needs according to the various treatment needs required for different oral diseases. Even though the percentage of people with prosthetic needs are less among Iruligas which could be due to their moderately good oral health, those who need prosthetic care are not aware of or not able to seek dental services. Most of the Iruliga settlements near villages are remote, and some with no access by road. Also, there are significant distances between villages. Most of the transportation is by public transport, which is not available to all villages. Hence considerable distance has to be covered by walking through Handi-Gundi hills and forest areas. This, coupled with cost of travelling, makes Iruligas reluctant to seek dental care. The primary health centres are the only sources of health services for these people which are usually situated far away from their settlements. Apart from these noted physical barriers, the cultural barriers to access oral care should be further evaluated in this population in future studies.

This study revealed less prevalence of oral diseases among Iruligas, but depicts the beginning of effects of modernization on oral health. The study also highlights the role of good oral health practices prevalent among this isolated population. Providing access to appropriate oral healthcare to the underserved segments of the population is a complex problem. It is imperative that the specific barriers to care for Iruliga population are identified and understood.

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