

# Gender and Ethnic Group Differences in Dental Caries in a Sri Lankan Population

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## ABSTRACT

**Aim:** To determine the caries prevalence rate of children and adolescent in contemporary Sri Lankan Sinhalese and aboriginal Vedda population.

**Materials and methods:** Dental caries rates were examined in two Sri Lankan ethnic groups of urban, westernized, market-integrated Sinhalese and rural, aboriginal Veddas with traditional culture. Two age-groups were studied in each ethnic group: 5–7-year olds and 12–15-year olds. A target sample of 563 subjects was recruited (373 contemporary Sinhalese 190 aboriginal Veddas).

**Results:** In 5–7-year age-group, caries prevalence and dmft were higher in females than males in Sinhalese while those of males were higher than females in Vedda. In 12–15-year age-group, Vedda showed higher caries prevalence and DMFT in males than those of females while Sinhalese showed the opposite where females had higher caries prevalence than males. When compared the caries prevalence and dmft/DMFT between Sinhalese and Vedda, in 5–7-year age-group, above parameters of both males and females were higher in Sinhalese than Vedda. The difference was statistically significant only in female dmft. In 12–15-year age-group, the pattern was opposite where caries prevalence and DMFT were higher in Vedda than Sinhalese in both the genders. Caries prevalence of 5–7-year age-group was significantly higher than that of 12–15-year age-group in both males and females of contemporary Sinhalese and Vedda.

**Conclusion:** Overall caries prevalence of 5–7-year and 12–15-year age-groups is 72.3% and 33.1%, respectively, in contemporary Sri Lankan Sinhalese and 63.9% and 40.3%, respectively, in Vedda. Furthermore, females of 12–15-year age-group do not demonstrate significantly higher caries rates than males in both the population groups. The caries prevalence in children is higher than adolescent in both genders of contemporary Sri Lankan Sinhalese and Vedda. This information is necessary in planning and implementing oral diseases prevention and health promotion programs.

**Keywords:** Aboriginal Vedda, Adolescents, Caries prevalence, Children, Ethnic group differences, Gender differences, Sri Lankan Sinhalese.

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## INTRODUCTION

The significance impact of caries on the world's population makes the disease an important topic of understanding. The development of caries is multifactorial, depending on many interrelating variables to promote its development. In particular, the presence of bacteria, a substrate for the bacteria (food/sugars), the host's oral environment, and the passing of times are the main causative factors in the formation of caries. Epidemiological and clinical studies through the use of tools, such as DMFT and DMFS scores, have revealed consistent trend in caries development, in which females having a higher prevalence than males.<sup>1,2</sup>

Are gender and even ethnic differences in oral pathology present in the living people of Sri Lanka? As emphasized earlier, epidemiological studies of dental caries rates commonly find that women have poorer oral health than men across a wide range of cultures and continents.<sup>1,3–5</sup> However, this trend has not been documented in Sri Lanka, despite the practical value of such a study for identifying “at-risk” groups, by gender and ethnicity. Lukacs has documented gender differences in oral health in prehistoric skeletal samples in India and Pakistan<sup>6,7</sup> and in the aboriginal inhabitants of Tenerife in the Canary Islands.<sup>1</sup> Though this female bias in oral health was present prior to the origin of agriculture, it became more pronounced in societies dependent on subsistence farming and intensive agriculture.<sup>8,9</sup> While differences in opinion exist about what factors contribute to this gender difference in oral health, anthropologists favor gender-based behavioral causes, while clinical practitioners tend to emphasize the importance of female hormones and pregnancy.<sup>10–14</sup>

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The present study holds significance at many levels and for different parties. At ground level, documenting the oral health status of two ethnic groups, by age and by gender, will improve the knowledge of intergroup differences in public health in Sri Lanka. This knowledge will provide a foundation for identifying groups “at risk” for poor oral health and will permit reallocation of oral health care resources to vulnerable groups. At another level, documenting dental caries rates for ethnic groups by gender will enable us to determine if gender differences in oral health in Sri Lanka are consistent with patterns observed in other cultures and continents. Only few relatively related studies of the kind investigated here in Sri Lanka has been reported in the literature,<sup>15–19</sup> a fact that heightens

the merit of the study by filling important gaps in research on the global epidemiology of oral disease.

The main objective of the present study was to investigate the prevalence of caries rate of children and adolescent in contemporary Sri Lankan Sinhalese and aboriginal Vedda population. In addition, we also investigated whether there was any significant difference in the caries rate between male and female children and adolescent, separately in contemporary Sri Lankan Sinhalese and aboriginal Vedda population. Furthermore, we examined whether there was any significant difference in the caries rate between children and adolescent in each contemporary Sri Lankan Sinhalese and aboriginal Vedda.

## MATERIALS AND METHODS

We examined dental caries rates in two modern Sri Lankan ethnic groups using the standardized World Health Organization (WHO)<sup>20</sup> methods for documenting dental caries prevalence and experience. The present study focused on urban, westernized, market-integrated Sinhalese and on rural, aboriginal Veddas with traditional culture. Two age-groups were studied in each ethnic group: 5–7-year olds and 12–15-year olds. Intraoral observation of dental caries was done by four qualified dental surgeons (Faculty of Dental Sciences, University of Peradeniya and Ministry of Health, Sri Lanka) with training and experience in observing and recording dental caries according to WHO guidelines. Interobserver agreement in the detection of caries was tested using the Kappa statistic to compare repeat observations by different pairs of dentists on the same subject. A target sample of 563 subjects were recruited: 129 males and 84 females of 5–7-years of age and 82 males and 78 females of 12–15-years of age from Sinhalese and 29 males and 31 females of 5–7-years of age and 54 males and 76 females of 12–15-years of age from Vedda were included. Subjects were selected from two government schools of Kandy district for Sinhalese and another two government schools from Anuradhapura Vedda villages of Kabathigollawa, Anuradhapura district for aboriginal Vedda.

Hypotheses tested focused on two comparisons: (a) interethnic differences in caries rates by age-group and gender and (b) differences in caries rates between children and adolescents in each ethnic group. Based on the prior meta-analyses of epidemiological research on oral health, we predicted that: (a) westernized diets may result in higher caries rates among Sinhalese than among Veddas who consume a more traditional diet and (b) that children (5–7-years) may exhibit no significant gender difference in caries, but that among adolescents (12–15-years), females will have significantly higher caries rates than males. These hypotheses were tested using appropriate inferential statistical methods for data on caries prevalence (percentage of individuals with caries; Chi-square test

of independence) and for experience (mean number of decayed, missing and filled teeth; Student's *t* test for independent samples).

Data collection protocol involved the following: (a) basic bio-data: age, gender, socioeconomic status; (b) height and weight; and (c) intraoral examination of the dentition for dental caries. Data were stored in Microsoft Excel files, while all statistical analyses were conducted using SPSS (ver. 17) for Windows.

A participant recruitment statement, description of research protocol, and informed consent statements have been approved by the Faculty Research Committee, Faculty of Dental Sciences, and Senate Research Committee, University of Peradeniya for the protection of Human Subjects (No: FDS-FRC/2013/03).

Free oral examination by qualified dental surgeons and a gift of a tooth brush and tooth paste was given to every participant, and it was a valuable incentive economically disadvantaged community like Vedda and even for contemporary Sri Lankan Sinhalese children. Furthermore, children who needed careful regular attention by a dental surgeon were identified and referred to the nearest government dental surgery unit with an official referral letter.

## RESULTS

Kappa statistic to compare repeat observations by different pairs of dentists on the same subject showed Cohen's Kappa value of 0.863 indicating good interobserver agreement.

Basic statistics for height and weight of each age-group of contemporary Sinhalese and Vedda are presented in Table 1. In contemporary Sinhalese, 5–7-year age-group height and weight of males were higher than those of females. However, the opposite was observed in Vedda of the same age-group where above parameters of females were higher than males. However, the differences were not statistically significant. On the other hand, in 12–15-age-group height of contemporary Sinhalese and Vedda males were higher than that of females while weight of those were higher in females than males. Nevertheless, differences were not statistically significant. When comparing contemporary Sinhalese and Vedda, in 5–7-year age-group, both height and weight were higher in Sinhalese males than Vedda males. Meanwhile, in females those parameters were larger in Vedda than contemporary Sinhalese. The difference of the height of females between the two ethnic groups was statistically significant at  $p < 0.01$ . On the other hand, in 12–15-year age-group, height and weight of both males and females were higher in contemporary Sinhalese than those of Vedda. However, differences were not statistically significant (Table 1).

Basic statistics of caries prevalence and dmft (The sum of the number of decayed, missing due to caries, and filled teeth in the deciduous dentition)/DMFT (The sum of the number of Decayed, Missing due to caries, and Filled Teeth in the permanent dentition)

**Table 1:** Basic statistics of the height and weight (*SD* is in parentheses) of contemporary Sri Lankan Sinhalese and Aboriginal Vedda of Sri Lanka

	<i>Sri Lankan Sinhalese</i>				<i>Aboriginal Vedda</i>				<i>Diff. SLSinha vs Vedda (Male)</i>	<i>Diff. SLSinha vs Vedda (Female)</i>
	<i>N</i>	<i>Male</i>	<i>N</i>	<i>Female</i>	<i>N</i>	<i>Male</i>	<i>N</i>	<i>Female</i>		
<b>5–7 years</b>										
Height	129	117.33 (7.19)	84	114.98 (13.62)	29	117.22 (6.24)	31	119.79 (6.00)	NS	**
Weight	129	19.64 (4.68)	84	18.64 (4.53)	29	18.82 (4.53)	31	19.74 (3.37)	NS	NS
<b>12–15 years</b>										
Height	82	153.95 (9.23)	78	151.48 (6.54)	54	152.42 (9.84)	76	150.15 (7.32)	NS	NS
Weight	82	42.01 (9.80)	78	42.89 (10.24)	54	38.88 (10.45)	76	40.09 (9.72)	NS	NS

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; NS, not significant

of each age-group of contemporary Sinhalese and Vedda are presented in Table 2. In 5–7-year age-group, caries prevalence and dmft were higher in females than males in contemporary Sinhalese while those of males were higher than females in Vedda. Differences were not statistically significant. In 12–15-year age-group, although not statistically significant, Vedda showed higher caries prevalence and DMFT in males than those of females while contemporary Sinhalese showed the opposite where females had higher caries prevalence than males. When compared the caries prevalence and dmft between contemporary Sinhalese and Vedda, in 5–7-year age-group, above parameters of both males and females were higher in contemporary Sinhalese than Vedda. The difference was statistically significant only in female dmft. However, in 12–15-year age-group the pattern was opposite where caries prevalence and DMFT were higher in Vedda than contemporary Sinhalese in both the genders. However, differences were not statistically significant (Table 2). In the meantime, caries prevalence of 5–7-year age-group was significantly higher than that of 12–15-year age-group in both males and females of contemporary Sinhalese and Vedda.

Overall, caries prevalence and dmft of 5–7-year age-group were 72.3% and 2.79, respectively, in contemporary Sri Lankan Sinhalese and 63.9% and 1.93, respectively, in Vedda. Furthermore, overall caries prevalence and DMFT of 12–15-year age-group were 33.1% and 0.61, respectively, in contemporary Sri Lankan Sinhalese and 40.3% and 0.66, respectively, in Vedda. Differences were not statistically significant (Table 3).

**DISCUSSION**

One potential limitation of this study was smaller sample size especially of the Vedda population. Although we expected to collect more male and female each from the two age-groups (5–7 and 12–15-years) due to several practical difficulties, we were able to collect 29 males, 31 females and 54 males, 76 females from 5 year to 7 year age-group and 12 year to 15 year age-group of Vedda, respectively. In addition, more favorable approach would have been to include children and adolescents from other Vedda settlements in Sri Lanka like Dambana, Wakarai, and so on. But this was not logistically feasible.

Many evidences are available in the literature to confirm higher caries among women of contemporary human populations.<sup>21–27</sup> However, some studies have reported no difference in caries rate between genders<sup>28</sup> while others found that males may occasionally have a higher rate of caries than females.<sup>29</sup> These findings confirm the complex and dynamic influences of physiological, behavioral, and environmental factors and their synergistic influence on caries rates. Caries rates in human populations are influenced by a variety

of genetic, behavioral, environmental, and physiological factors. A greater understanding of gender differences in caries prevalence can be obtained by considering each of these influences, the relative impact of which will vary by cultural affiliation, environment and genetic constitution.

The underlying mechanisms of any genetic contributions to the increased prevalence of caries in females than males can be speculated to reside in the sex chromosomes, exhibiting sex-linked modes of inheritance. Variations in the genes present on the X and Y chromosome whose function affects those factors which contribute to the development of caries would alter the host’s oral environment and the host’s response to the initiation of caries. It has been described that a mutation or deletion of the *AMELX* gene which is located on the p arm of the X chromosome and responsible for the production of amelogenin which is a major component of enamel matrix protein leads to decreased production of amelogenin and therefore, disrupt the formation of enamel matrix and increase the caries susceptibility.<sup>30</sup> Studies explained that in females, it is possible for this kind of variation in *AMELX* to occur through the mechanisms of X inactivation and mosaicism<sup>30</sup> and, therefore, it may be the possible genetic contribution to have higher caries prevalence among females than males. The composition and flow rate of saliva in the host oral environment seem to be another contributing factor for susceptibility of caries formation in women. Saliva plays a protective role in the oral cavity through its buffering, mechanical washing, antimicrobial, and remineralization activities. However, the flow rates of saliva and compositional analysis have been shown to be generally less protective in women than in men. In addition, the hormonal fluctuations in women in puberty and

**Table 3:** Basic statistics of overall (male and female combined) prevalence of caries (N is in parentheses) and dmft/DMFT (SD is in parentheses) in contemporary Sri Lankan Sinhalese and aboriginal Vedda

	Sri Lankan Sinhalese		Aboriginal Vedda		Difference
	N		N		
<b>5–7 years</b>					
Caries prevalence (%)	213	72.3 (154)	60	63.9 (39)	NS
dmft	213	2.79 (2.83)	60	1.93 (2.24)	NS
<b>12–15 years</b>					
Caries prevalence (%)	160	33.1 (53)	130	40.3 (53)	NS
DMFT	160	0.61 (1.23)	130	0.66 (1.05)	NS

NS, not significant

**Table 2:** Basic statistics of the prevalence of caries (N is in parentheses) and dmft/DMFT (SD is in parentheses) in contemporary Sri Lankan Sinhalese and Aboriginal Vedda

	Sri Lankan Sinhalese				Aboriginal Vedda				Difference SL Sinh: vs Vedda (Male)	Difference SL Sinh: vs Vedda (Female)
	N	Male	N	Female	N	Male	N	Female		
<b>5–7 years</b>										
Caries prevalence (%)	129	69.8 (90)**	84	76.2 (64)**	29	62.5 (20)*	31	59.4 (19)*	NS	NS
dmft	129	2.65 (2.88)	84	3.01 (2.74)	29	2.17 (2.15)	31	1.71 (2.34)	NS	##
<b>12–15 years</b>										
Caries prevalence (%)	82	30.1 (25)	78	35.9 (28)	54	43.6 (24)	76	38.2 (29)	NS	NS
DMFT	82	0.62 (1.18)	78	0.60 (1.29)	54	0.78 (1.11)	76	0.58 (0.99)	NS	NS

Asterisk denotes the significant difference of caries prevalence between two age-groups. \*p <0.05; \*\*p <0.01; NS, not significant; #p <0.05; ##p <0.01; NS, not significant

pregnancy tend to play a role in the less protective composition and flow rate of saliva.<sup>31,32</sup> Studies have shown that mean flow rate of whole saliva is less in women than men in both major and minor salivary glands.<sup>33</sup> In addition, the report by Eliasson et al.<sup>34</sup> highlights difference in IgA concentration which is protective against caries, between men and women with women having a lower concentration of the protective IgA from minor glands.

In the present study, caries prevalence was higher in females of contemporary Sri Lankan Sinhalese in both the age-groups of 5–7 and 12–15 years. On the other hand, different pattern was observed in aboriginal Veddas having higher caries prevalence in males than females in both the age-groups. Therefore, the results of the present study are only partly in accord with several previous studies which have concluded that females have higher caries prevalence rate than males. The inconsistency in the result of caries prevalence in males and females of Veddas and contemporary Sri Lankans further confirms the multifactorial influence on caries rates. Genetic, behavioral, and environmental differences between Vedda and contemporary Sinhalese may have contributed to the different pattern of caries rates observed in males and females.

It is understood that hormonal fluctuations of estrogen occur in female during pregnancy, menstruation, and puberty. These elevated estrogen levels can lead to significant changes in the environment of the oral cavity.<sup>1</sup> Lukacs and Lergaespada<sup>1</sup> found a causal link between caries rate and estrogen levels but similar androgen-level fluctuations experienced by males did not show this same link or even a correlation. Meanwhile, pregnancy can also have negative effects on salivary flow, impairing the protective washing and buffering mechanisms of saliva against caries development. The study discussed earlier by Eliasson et al.<sup>34</sup> compared testing whole saliva rates of pregnant women with control (nonpregnant) women and found that the pregnant women had a mean secretion rate less than their control counterparts. In the present study, we investigated caries prevalence in two age-groups; one before puberty and one after puberty. If above phenomenon is true, females of 12–15-year age-group should demonstrate higher caries rate than males of the same age-group. However, in the present study, although the caries prevalence and DMFT of 12–15-year females of contemporary Sri Lankan Sinhalese was higher than males, in Vedda those parameters were lower in females than males. Interestingly, similar pattern was seen in the 5–7-year age-group as well. Therefore, result of the present study does not completely agree with the fact that hormonal changes which take place in puberty influence on caries prevalence rate. However, although not within the purview of the present study, it is important to note that still one cannot completely disregard the fact that hormone fluctuations of estrogen during pregnancy may lead to high caries risk in females during pregnancy.

Dietary habits can have a major impact on caries prevalence based on the form and frequency of the food. In many cultures historically, women have been the family member with the responsibility of food preparation. This would allow easier access to foods and snacks outside of meal time, which would provide bacteria in their oral flora with more substrate for caries development.<sup>35</sup> However, these phenomena are not applicable to present study because the two age-groups selected for the study are school age and not actively involved in food preparation.

In the present study, caries prevalence of 5–7-year children was higher in contemporary Sri Lankan Sinhalese than Vedda in both males and females. In 2010, Perera and Ekanayake<sup>16</sup> investigated the caries prevalence in a mix group (male/female and ethnic groups mixed) of 15 year old adolescent in the Colombo district

and reported the caries prevalence as 47% which is higher than in the present sample of Sri Lankan Sinhalese (male: 30.1%, female: 39.5%). Furthermore, in 2002, Dasanayake and Caufield<sup>15</sup> recorded the caries prevalence of 5–17-year old Vedda children as 28% which is comparatively lower than the present study. This may be due to several reasons such as lower sample size, being a mixed sample, wider age range, and so on, in the study of Dasanayake and Caufield.<sup>15</sup> Furthermore, mean dmft of 5–7-year females was significantly higher in contemporary Sinhalese than Vedda. This may be directly related to more traditional mostly sugar-free food pattern and habits in Vedda than contemporary people who consume more refined sugary foods in day-to-day life. However, this pattern was different when it comes to 12–15-year age-group. Although the caries prevalence is generally lower in this age-group than that of 5–7-year group caries rate is higher in Vedda than Contemporary Sri Lankan Sinhalese in both males and females. The higher caries prevalence and mean DMFT observed in Vedda of 12–15-years may be attributed to more access to refined sugary foods in day-to-day and rapidly changing life style, especially in relation to dietary practices and lower access to dental health care workers and lack of interest and motivation on oral well-being. Although we anticipated lower caries experience in Vedda children and adolescents than those of contemporary Sri Lankan Sinhalese, the differences in the present study were not very supportive except that of females of 5–7-year age-group. Meanwhile, National Oral Health Survey Sri Lanka—2015–2016 has reported that caries prevalence of Sri Lankan males of 5 year and 15 year age-group as 62.6% and 38.6%, respectively, and females of those age-groups as 63.6% and 44.5%, respectively. Although the present study showed comparatively higher values for 5 year age-group and lower values for 15 year age-group than National Oral Health Survey results the overall trend showed a similarity with females having higher caries prevalence than male in the both the age-groups and children showing higher caries prevalence than adolescents. Furthermore, the same survey reported the dmft/DMFT of males of 5- and 15 year age-group as 3.6 and 0.9, respectively, and females of those age-groups as 3.5 and 1.1, respectively. Although dmft/DMFT values are lower in the present study than the National Oral Health Survey results the overall trends are similar.

Another interesting observation is that the prevalence of caries in primary teeth (5–7-year age-group) is higher compared with that of the permanent teeth (12–15-year age-group) in both contemporary Sinhalese (male:  $p < 0.001$ , females:  $p < 0.001$ ) and Vedda (male;  $p < 0.05$ , females;  $p < 0.05$ ). Furthermore, the difference was more obvious in contemporary Sinhalese. This is further supported by an analysis of cross-sectional data from the U.S. National Survey indicating a similar result.<sup>36</sup> It is interesting to further investigate whether hormonal changes in puberty do have an effect on the reduction in caries prevalence in 12–15-year age-group than that of 5–7-year group. However, other factors like higher awareness about the oral health in older age-group, better oral hygiene, and so on may have played a role for this difference.

Height and weight of males and females of contemporary Sinhalese and Vedda of both age-groups did not show consistent pattern. For example, height and weight of contemporary Sinhalese male were higher than those of Vedda in the 5–7-year age-group while those parameters of females were higher in Vedda than contemporary Sinhalese in the same age-group. Similar inconsistency was observed in the 12–15-year age-group as well. This further confirms that change in the life style of especially Veddas have greatly contributed to their food pattern and health status.

## CONCLUSION

In conclusion, the present study does not conclusively show lower caries prevalence in Vedda than contemporary Sri Lankan Sinhalese. Lower caries prevalence is observed in Vedda of 5–7-year age-group but not in 12–15-year age-group. Furthermore, females of 12–15-year age-group do not demonstrate significantly higher caries rates than males in both the population groups. The present study revealed that caries prevalence in children is higher than adolescent in both genders of contemporary Sri Lankan Sinhalese and Vedda. Overall caries prevalence of 6–8-year and 12–15-year age-group are 72.3% and 33.1%, respectively, in contemporary Sri Lankan Sinhalese and 63.9% and 40.3%, respectively, in Vedda.

## Clinical Significance

The present study revealed the caries rates of children and adolescent in contemporary Sri Lankan Sinhalese and aboriginal Vedda population. This information is necessary in planning and implementing oral diseases prevention and health promotion programs.

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