ABO Blood Grouping: A Potential Risk Factor for Early Childhood Caries - A Cross-sectional Study

Abstract

Aim: The paradigm of etiology of early childhood caries (ECC) is shifting toward genetics. Of various inherited factors, blood group of an individual is genetically determined. The aim of the study is to determine if blood group of an individual will serve as a potential risk factor in the development of ECC. Materials and Methods: A cross-sectional study was conducted in Chennai. Blood samples were collected from a total of 500 children <71 months of age for determination of the blood group. Of which 96 children (24 per blood group) were randomly selected and were included in the study. Oral screening of the selected children was done by a pediatric dentist who was blinded to the blood group of the children. Decayed, extracted, and filling index was noted. Details on other associated factors for the development of ECC such as the socioeconomic status, oral hygiene measures, diet, and feeding practices were collected by directly interviewing the parents through a questionnaire. Statistical analysis was done using Chi-square and Kruskal–Wallis test and post hoc Tukey test with significance level set at 0.05. Results: Intergroup analysis of the associated factors showed no significant differences between the children of different blood groups. A statistically significant relation was noted between the blood groups and development of ECC (P = 0.025). Conclusion: Blood group is a potential risk indicator for the development of ECC.

Keywords: Blood group, children, early childhood caries, risk factor

Introduction

Early childhood caries (ECC) is a global dental problem in children.[1,2] Interaction between the cariogenic organisms, fermentable carbohydrates and the susceptible tooth along with the other factors like inappropriate feeding practices, dental plaque and socio-economic status causes ECC.[3-8] Irrespective of the exposure to these risk factors, there are individuals who are more susceptible to caries and others who are resistant to the development of caries. The individual’s susceptibility to ECC has changed to genetics as dental caries is a complex interaction of the genetics and the environmental factors. Various twin and linkage studies play a role in shedding light on the influence of genes in the development of caries.

Blood group is one such inherited genetic character. ABO method of classifying blood groups is universal. Many medical diseases show preferences among ABO blood type.[9] Limited research is carried out with respect to oral diseases. In dentistry, the periodontal diseases and the salivary gland tumors have an association to blood groups.[10-13] The correlation between dental caries and blood group has been studied and the conclusion is nondeterministic.[16-19] Hence, the aim of the current study was to determine if blood group is a potential risk factor for the development of ECC.

Materials and Methods

Study design and sample characteristics

A cross-sectional study was carried out in Chennai, Tamil Nadu, to evaluate the association between ECC and ABO blood groups. Ethical Committee approval of the protocol was obtained before the start of the study (STP/SDMDS2015PED42).

The sample size was calculated with the power set at 0.95 which determined a minimum sample of 96 children (24 children per blood group). The blood samples were collected from a total of 500 children. The study population comprised children below 6 years of age (till 71 months). The children whose parents who did not give the consent and who did not cooperate during the examination was excluded from the study.

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Systematic sampling was adopted for the randomization. Of 500 received samples, the first 25 children in each blood group were included in the study.

**Blood group analysis**

Nonfasting venous blood was collected from the children and was analyzed by a single laboratory technician to avoid any bias.

**Data collection**

A self-administered questionnaire was prepared by two researchers addressing the socioeconomic status, oral hygiene practices, dietary habits, and feeding practices of the children [Figure 1]. Validation of the questionnaire was done by test-retest method. The parents/guardian of the participants was interviewed individually by the researchers to avoid misunderstanding of the questionnaire.

**Oral examination**

The dental examinations of the selected children were performed in a school premises under natural light and with disposable mouth mirrors. The Decayed, extracted and filled deciduous tooth (def) status of the children was assessed by a pediatric dentist who was not a part of this study. The pediatric dentist who did the examination was blinded to the blood group of the participants.

**Statistical analysis**

Data analysis was performed using SPSS software version. Chi-square test was used to compare the other associated factors of ECC between the four blood groups. Kruskal–Wallis test and post hoc Tukey test were performed to investigate the correlation between blood group and ECC.

**Results**

Among the 100 participants, 46% were male and 54% were female. Sixty-two percent of the children belonged to the upper middle class. The demographic details of the participants are explained in Table 1. Demographic analysis showed no significant difference in age, sex, and socioeconomic status between the four blood groups.

Intergroup analysis was done between the four groups with respect to the oral hygiene practice, diet habits, and feeding practices. No statistically significant difference was noted as depicted in Table 2.

The def score was higher in children with AB blood group and was lowest in the children with O blood group. The distribution of the def score among the blood groups is shown in Table 3. An intergroup comparison was done between the def scores and blood groups using Kruskal–Wallis test. A statistically significant difference was obtained, \( P = 0.025 \). Post hoc Tukey test applied for intergroup comparison of the def scores between the four blood groups is depicted in Table 4.

**Discussion**

The paradigm of pathogenesis of ECC is shifting toward host-related risk factors—“the Genetics.” The susceptibility
In 1900, Landsteiner explained the existence of serological differences between the individuals based on the presence or absence of different agglutinogens (antigen A, B) on the surface of the red blood cells and classified blood group into four groups. Blood groups being inherited from the parents are controlled by ABO gene, which is located on the long arm of the 9th chromosome (9q34). ABO gene comprises three types of alleles – I^A, I^B, i, where I stands for isoagglutinogen. Individuals with A blood group contain either IAIA or IAi; individuals with B blood group contain IBIB or IBi; individuals with AB blood group carry IAIB; and individuals with i allele belong to O blood group. Earlier studies have stated that ABO blood system determines the immunological characteristics of the body.

In the present study, all the environmental factors associated with ECC were assessed in the individuals with four blood groups. The associated risk factors vary from population to population. Harris et al. have stated that low socioeconomic status increases the risk of ECC. In the present study, socioeconomic status of the children was assessed and 62% of the children were from upper middle class. No statistically significant difference was noted between the groups ($P = 0.373$).

Dental plaque accumulation is considered to be a risk factor for the initiation of ECC. Vanobbergen et al. and Tsai et al. in 2001 have reported that a brushing habit of a child, the frequency of brushing, and the use of fluoride toothpastes are associated with the development of ECC. Similarly, children who do not brush their teeth at night have been found to have an increased risk of developing ECC. Hence, in the present study, oral hygiene practices such as the frequency of brushing, use of fluoridated toothpaste, and use of other auxiliary aids were assessed among the children.

The role of sugars and other fermentable carbohydrates in the process of initiation of ECC are evident from various studies. In the present study, questions were directed toward the dietary habits of the children such as in between snacking, sweet consumption, consumption of fruits, and other carbonated drinks.

With respect to the feeding habits, Du et al. have found that children who had been bottle fed had 5 times higher risk of developing ECC than those children who were breastfed. While other studies have indicated that prolonged breastfeeding is associated with the development of ECC. The length of feeding is another factor that has to be considered. The WHO recommends breastfeeding till 24 months of age while American Diabetes Association recommends weaning of breast milk soon after the child’s first birthday. The relationship between ECC and breastfeeding remains to be a controversial topic. In the current study, the method and duration of feeding and presence/absence of night time feeding were assessed.

All the above environmental contributors to the development of ECC were compared between the subjects of four blood groups and there was no statistically significant difference observed.

Despite no significant difference present in the epigenetic factors, in the present study, subjects with AB blood group had a higher number of decayed teeth ($5.28 \pm 5.311$) while the prevalence of ECC was low in subjects with O group ($2.12 \pm 3.993$). Statistical analysis showed that this difference was statistically significant with $P = 0.025$.

Singla et al. in 2015 studied the correlation between dental caries and blood group in western Punjab population in India and concluded that the incidence of dental caries was higher in A and B blood groups and lower in O and AB blood group. Furthermore, he stated that blood group plays a significant role in the development of dental caries. In other studies, no significant correlation was obtained between the blood groups and dental caries. These studies have also shown that the prevalence of dental caries was lower in subjects with AB blood group. However, in all these studies, the subjects were not equally distributed among the four groups. The number of subjects with AB blood group was low in all the above-mentioned studies. To overcome this bias in the present study, the subjects were equally distributed (25 subjects per group).

### Table 3: Association between early childhood caries and blood group

| Blood group | n   | def score | P     |
|-------------|-----|-----------|-------|
| A group     | 25  | 2.32±2.719| 0.025 |
| B group     | 25  | 3.28±4.560|       |
| AB group    | 25  | 5.28±5.311|       |
| O group     | 25  | 2.12±3.993|       |

Kruskal–Wallis test, $P<0.05$ significant. def=Decayed, extracted and filled deciduous tooth

### Table 4: Post hoc Tukey test for def status

| Groups  | Subgroups | Significant |
|---------|-----------|-------------|
| A group | B group   | 0.855       |
|         | O group   | 0.998       |
|         | AB group  | 0.073       |
| B group | A group   | 0.855       |
|         | O group   | 0.770       |
|         | AB group  | 0.349       |
| O group | A group   | 0.998       |
|         | B group   | 0.770       |
|         | AB group  | 0.048       |
| AB group| A group   | 0.073       |
|         | B group   | 0.349       |
|         | O group   | 0.048       |

$P<0.05$ significant. def=Decayed, extracted and filled deciduous tooth
One possible reason for lesser prevalence of ECC in individuals with specific blood group is due to the increase in the levels of antibodies produced against the bacteria. O carries both anti-A and anti-B antibodies which protects against certain strains of bacteria causing ECC and hence resulting in lesser prevalence of ECC. While AB has no antibodies associated resulting in increased prevalence of ECC, which is in accordance to the results obtained in the present study. ABO blood groups have also shown significant differences in the rate of colonization of the pathogens.

This reason can be further substantiated from the results obtained in the post hoc Tukey test done in the present study. A statistically significant difference with respect to the df scores was noted only between AB and O blood groups (P = 0.048).

The limitations of the present cross-sectional study involve the exclusion of the Rh−ve blood groups as they were very less in number. Furthermore, the secretor status was not determined.

Further studies have to be conducted at the molecular level to confirm the findings of the current study.

Conclusion
The results of the current study demonstrate that:
1. There is a significant correlation between blood groups and initiation of ECC. Hence, blood groups are potential risk indicator for the development of ECC
2. Children with AB blood group are at a higher risk of developing ECC
3. Children with O blood group are less likely to develop ECC.

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Conflicts of interest
There are no conflicts of interest.

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