# Association between caries index and black extrinsic strains among college students in Firozpur

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## Abstract

The discoloration on the dentition, often referred to as stains, present a unique and multifaceted challenge in the field of dentistry. These stains are typically attributed to chromogenic bacteria, which produce pigmented by-products that adhere tenaciously to the tooth surface. The aesthetic impact of stains cannot be understated as they often lead to significant patient dissatisfaction and self-consciousness. Therefore, managing stains is vital for the overall well-being of the patient. It not only requires professional skill but also a holistic understanding of a patient's lifestyle and health, making it a complex yet rewarding aspect of dental care._To evaluate the prevalence and the correlation between extrinsic black stains and dental caries among students in Punjab._Clinical examination of the target population consisting of 300 students aged between 18-30 years of age was done by dental professionals, according to the world health education criteria for caries diagnosis. Chi square Test was used for comparison between different groups. _Black stains were observed in 30 students i.e. 10% of the samples, the mean DMF-T was 0 for students with black stains and 1.56+/- 1.95 for students without black stains._A negative correlation was observed between the presence of black stains and DMF-T values.

Keywords: **Caries index, Black extrinsic strains, DMFT, Firozpur**

## Introduction

Stains on the dentition are referred to as discolorations often caused by the chromogenic bacteria that produce pigmented by-products which adhere to the tooth surfaces.(1) Stains are one of the common concerns regarding the dental problems persisting in the present day population. They often cause cosmetic concerns for the patients, presenting a significant clinical challenge for a dental professional. The etiology, appearance, severity and areas affected varies from patient to patient.(2) These stains however based on their nature and origin are of two major types i.e., intrinsic stains and extrinsic stains.(3) Intrinsic stains are those which affect the inner structure of the tooth beneath the enamel usually when the tooth structure is penetrated by pigmented materials during tooth development. These stains can result from congenital or systematic influence or conditions passed forward in inheritance.(3) Extrinsic stains are surface level discolorations that affect the outer layers of the teeth, preferably enamel. These stains are often caused by external factors such as consuming staining substances like coffee, tea, red wine, tobacco, etc.(5) In this study, we are going to discuss the black extrinsic stains of the dentition. According to Reid et al, the black color of the stains is due to a ferric salt i.e., ferric sulfide which is a byproduct of hydrogen sulfide produced from bacterial action and the iron from saliva.(6) However, the definite origin still remains obscure.(2) To assess and evaluate their prevalence and to further study about their effect on dentition, it is important to record them by the help of diagnostic tools like DMF-T index. However, up till recently, a considerable amount of literature regarding the association between black stains and dental caries is to be found but further research is vital to fully understand this association.

## Materials and Method

### Study Design and Ethical Approval

This was a cross-sectional, observational study conducted to evaluate the association between black extrinsic stains and dental caries among college students in Firozpur, Punjab. The study protocol was reviewed and approved by the Institutional Ethical Committee (Ethical approval number: [Insert Approval Number]).

### Study Population

The study included a total of 300 students aged between 18 to 30 years. Participants were recruited from local colleges in Firozpur through voluntary participation. Written informed consent was obtained from all participants after explaining the purpose and procedures of the study.

### Inclusion Criteria

- Students aged 18 to 30 years.
- Participants with permanent dentition.
- Willing to provide informed consent.

### Exclusion Criteria

- Individuals with developmental dental anomalies.

- Those who had undergone recent professional dental cleaning (within the past 3 months).
- Students with systemic illnesses or on long-term medications that may influence oral health.

**Clinical Examination**

All examinations were conducted by calibrated dental professionals with a minimum of five years of clinical experience. Examiners were trained and standardized for diagnosis using the World Health Organization (WHO) criteria for dental caries detection.

Examinations were carried out under natural daylight using plane front surface mouth mirrors and blunt explorers. No radiographic evaluation was included.

**Assessment Tools**

- **Dental Caries** was recorded using the **Decayed, Missing, and Filled Teeth Index (DMF-T)**, in accordance with WHO guidelines.
- **Black Stains** were identified based on **Koch's criteria**, which define them as dark pigmented lines or dots parallel to the gingival margin on the buccal or lingual surfaces of at least two permanent teeth.

To ensure intra-examiner reliability, every 10th subject was re-examined throughout the study, and findings were cross-verified.

**Statistical Analysis**

Data were entered into Microsoft Excel and analyzed using SPSS version [Insert Version, e.g., 25.0]. Descriptive statistics including means and standard deviations were calculated for DMF-T scores. Chi-square tests were used to assess associations between the presence of black stains and dental caries prevalence. An independent t-test was applied to compare mean DMF-T scores between groups with and without black stains. A p-value of $<0.05$ was considered statistically significant.

## Results

**Prevalence of Black Extrinsic Stains**

Out of the total sample of 300 students aged 18–30 years, black extrinsic stains were clinically detected in 30 participants (10%), while 270 participants (90%) showed no evidence of such pigmentation. A statistically significant association was observed between age group and the presence of black stains ($\chi^2 = 9.58$, $p = 0.002$), with a higher prevalence among the 24–29 years age group (20%) compared to the 18–23 years age group (6.7%).

**Dental Caries Experience (DMF-T Scores)**

The mean Decayed, Missing, and Filled Teeth (DMF-T) score for the total sample was **1.40 ± 1.91**. When stratified by age:

- **18–23 years group (n = 225):** Mean DMF-T = **1.20 ± 1.91**
- **24–29 years group (n = 75):** Mean DMF-T = **2.00 ± 1.80**

An independent t-test revealed a statistically significant difference in DMF-T scores between the age groups (**t = 3.32, p = 0.001**), indicating higher caries experience in the older cohort.

**Association Between Black Stains and Caries Experience**

The mean DMF-T score among participants with black stains was 0.00 ± 0.00, whereas among those without black stains, it was 1.56 ± 1.95. The difference was statistically significant ($t = -4.56$, $p < 0.001$), suggesting an inverse relationship between the presence of black extrinsic stains and dental caries.

| Black Stain Status | n | Mean DMF-T ± SD | Minimum | Maximum | p-value |
|---|---|---|---|---|---|
| Absent | 270 | 1.56 ± 1.95 | 0 | 6 | <0.001* |
| Present | 30 | 0.00 ± 0.00 | 0 | 0 | |

*Independent t-test, $p < 0.05$ considered statistically significant

**Caries Prevalence According to Black Stain Presence**

Of the 30 participants with black stains, **none had a DMF-T score above zero** (i.e., no caries), while among the 270 participants without black stains, **135 (50%)** had evidence of dental caries (DMF-T > 0). The association was statistically significant (**$\chi^2 = 15.00$, $p < 0.001$**).

**Stratified Analysis of DMF-T Score Categories and Black Stains**

A series of Chi-square tests were conducted to analyze the prevalence of black stains in subgroups with varying DMF-T score thresholds:

1. **DMF-T ≤ 1 vs. > 1**
    - Black stains present in **100%** of subjects with DMF-T ≤ 1
    - **$\chi^2 = 11.76$, $p < 0.001$**
2. **DMF-T ≤ 3 vs. > 3**
    - Black stains present in **100%** of subjects with DMF-T ≤ 3
    - **$\chi^2 = 7.50$, $p = 0.001$**

These findings further reinforce the negative correlation between black extrinsic stains and the severity of caries.

**Summary of Key Findings**

- Black extrinsic stains were inversely correlated with DMF-T scores.
- Older students (24–29 years) showed significantly higher black stain prevalence and higher caries indices overall.
- Participants with black stains exhibited no caries, suggesting a possible protective or microbial association.

**Discussion**

With the advent of new preventive techniques and increased dental awareness among people, the prevalence of caries has decreased.(2) However, the study was conducted in an area with no water fluoridation facility to avoid any false results thereby preventing any bias before and during the study. The prevalence of black stains in several groups of population when studied worldwide is found to be relatively less. Similar results have been found in our study in which only 30 i.e. 10% of total students examined had black stains, thus, depicting a low prevalence of

these pigmentation on the dentition. In the study conducted by Gasparretto in 2003 on the prevalence of black tooth stains and dental caries in Brazilian school children, it was observed that a prevalence of 9.3% of black stains in children aged 6 to 13 years and a prevalence of 2.5% in children aged 3 to 5 years was seen.(3) According to a study by Surekha Bhatt in 2010 among Udaipur school children, a lower DMF-T was reported in a population with black stains. However, way back in 2001, Koch et al conducted a study in school children in Potenza, Italy where similar findings were seen i.e., a lower DMF-T score was seen in subjects with black stains. The data mentioned above is in agreement with the outcome of the present study done on permanent dentition.(9) However, the mechanism which leads to the lower caries prevalence in people with black stains need to be studied.

Black discolouration is a special form of pigmentation containing insoluble iron salts and high content of calcium and phosphate. This black staining of the dentition might be the result of the reaction between the hydrogen sulfide and iron to form ferric sulfide. Hydrogen sulfide is produced by bacterial action, which reacts with iron present in the saliva or gingival exudate that is GCF leading to the formation of ferric sulfide. There might be some association between chromogenic bacteria such as actinomyces and prevotella melaninogenica in this mechanism.(10) Also, the flora of this plaque might increase its tendency to calcify, as a result of which the level of calcium phosphate increases in the oral cavity. High levels of calcium and phosphate reduces enamel dissolution and thereby increasing the buffering capacity of the enamel of the tooth. It has been found that the subjects having low prevalence or susceptibility of dental caries, have saliva rich in calcium, inorganic phosphates, copper, sodium and proteins and deficit in glucose. However, the mechanism of accumulation of these minerals is not clear. The statistical differences were to be found between the study groups on the presence of black stains and the caries prevalence in the subjects of the study. A significant correlation was found between the presence of extrinsic black stains and the prevalence of dental caries in permanent dentition as evaluated by the DMF-T index. The mean DMF-T values in students with black stains were observed to be relatively less than the mean DMF-T of those students with no black stains. Therefore, the presence of extrinsic black stains depict a low prevalence of dental caries in the permanent dentition.

## Conclusion

A special form of dental plaque forms black extrinsic stains. The prevalence of these black stains is relatively low in the general population. The predominant bacteria are facultative aerobic, and anaerobic rods, typical of actinomyces israelii and actinomyces naeslundii. Due to high levels of calcium and phosphate in this type of plant tooth becomes resistant to dental cases. The Flora plays a significant role. However, preventive programs can be planned keeping in view the findings of the study where higher mean DMF-T was found in subjects with black stains. For the research is needed to fully understand the nature, it ology and carries protective properties of black staining.

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