Assessment of Racial and Socioeconomic Status as Factors Affecting Emergence of Permanent Teeth among a Group of Egyptian and Sudanese Children

Eman Korayem¹, Nancy Ahmed Khattab², Mohammed Abou El-Yazeed³, Nayera E Hassan⁴ and Tamer Mahmoud Abd El Wahab⁵

¹Assistant Researcher, Orthodontics and Pediatric Dentistry Department, Oral and Dental Research Division, National Research Centre, Dokki, Giza, Egypt.
²Prof. of Physical Anthropology, Anthropology Department, Faculty of African Postgraduate Studies, Cairo University, Egypt.
³Prof. of Pediatric Dentistry, Head of Orthodontics and Pediatric Dentistry Department, Oral and Dental Research Division, National Research Centre, Dokki, Giza, Egypt.
⁴Prof. of Biological Anthropology, Head of Biological Anthropology Department, Medical Research Division, National Research Centre, Dokki, Giza, Egypt.
⁵Lecturer of Physical Anthropology, Anthropology Department, Faculty of African Postgraduate Studies, Cairo University, Egypt.

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ABSTRACT

Introduction: Tooth emergence is influenced by various factors, one of them is socioeconomic status (SES) and race. This study was aimed to assess the relationship between the number of permanent teeth emerged with socioeconomic status in 5-13 years old Egyptian and Sudanese Nubian children.

Methods: this study was a cross sectional carried out on 2000 Egyptian and Sudanese Nubian children. The Socioeconomic status of the participants was determined using Fahmy modified index. This index was designed for evaluation of the social status of families, to be used in health research in Egypt.

Results: A negative week correlation was found between socioeconomic status and emergence of permanent teeth in the whole studied sample r = -0.056 in Egyptian children and -0.101 in Sudanese Nubian children. Conclusion: There is a relationship between socioeconomic status and the number of permanent teeth emerged in Egyptian and Sudanese Nubian children aged 5-13 years old. The higher the socioeconomic status of a child, the less number of permanent teeth emerged. Sudanese Nubian children have earlier permanent teeth emergence than Egyptian children.

Keywords: Socioeconomic status, permanent teeth emergence, Race

1. Introduction

Tooth emergence is the movement of a tooth from its position in the osseous crypt into the oral cavity. Although the exact mechanisms controlling this process are not fully known, many factors appear to play a role (Lailasari et al., 2018).

Many factors associated with teeth emergence have been widely investigated. Factors that causing differences might be racial, genetics, gender, nutrition, preterm birth, socioeconomic factors, height and weight, craniofacial morphology, hormonal factors, and systemic diseases. (Anusha et al., 2018; Alshukairi, 2019).

The socioeconomic status of a person has also been associated with variations in the timing and pattern of tooth emergence of the primary dentition in some populations. Children from higher socioeconomic status have been shown to have earlier tooth emergence compared to those from a low socioeconomic status (Kaur et al., 2010; Shaweesh et al., 2011; Fatmasari et al., 2019). (4–6). It is settled that the better health care received by children from higher socioeconomic status influences
earlier dental development. However, this theory is disputed by other studies where no association has been observed among different socioeconomic groups (Reyes-Perez et al., 2014; Kutesa et al., 2019).

Some researchers found that the permanent teeth emergence sequence is different among children from different socioeconomic classes. The first teeth to erupt in children from higher socioeconomic status in the oral cavity is the mandibular incisor as opposite to mandibular first molar in children from the lower class (Kutesa et al., 2019, Carneiro et al., 2017).

Research on the timing and sequence of emergence of permanent and primary teeth was done in different races and ethnic groups across many parts of the world (Feraru 2011; Khan, 2011; Chaitanya et al., 2018; Thabrani et al., 2020).

Both longitudinal and cross-sectional studies reported differences in teeth emergence time among different races. Permanent teeth emerge considerably earlier in African and American-African children than in Asians and Caucasians. People of Afro-Caribbean lineage have been shown to have an earlier eruption pattern when compared to other ethnic groups (Feraru 2011; Chaitanya et al., 2018).

This study was designed to assess the correlation between socioeconomic status as a factor affecting the emergence of permanent teeth, also to assess the role of sex and race in permanent teeth emergence among a sample of Egyptian and Sudanese Nubian children.

2. Subjects and Methods
2.1. Ethical consideration
This study was reviewed and approved by the Ethical Committee for Medical Research of the National Research Centre, reference number (18/111). Also prior to carrying out the research, parents were informed about objectives of this study and their permission in the form of written informed consent was taken.

This was a cross sectional study of children aged 5 to 13 years. It was carried out on two populations, Egyptian and Sudanese Nubian. Two thousand children from Cairo and Sudanese Nubia were enrolled in this study.

One thousand children (477 males and 532 females) from Cairo governorate and 1000 Sudanese Nubian children (494 males and 506 females) were selected from 3 Sudanese schools in Giza Governorate- Egypt. A child was included in the examination if he or she regarded as Sudanese as determined by the race of his parents. Accurate birthday was available from either the parent supported by birth certificates or from the school registrant (personal school chart for each child). Each race was divided into 8 groups according to their ages as shown in table (1).

All children fulfilling the inclusion criteria were selected aged from 5 to 13 years, in their mixed dentitions, free from any genetic disorders and apparently healthy (free from any systemic or chronic diseases). Children with supernumerary teeth and history of congenital and systemic disorders were excluded from the study.

Medical history of each child was obtained from either parents or from medical records in the school.

Each child was subjected to:
1. Clinical Examination
Clinical examination was carried out using a wooden spatula to retract soft tissues, starting from the posterior right side of the mandibular and then anterior and posterior to the left mandible, then the left maxillary posterior teeth then anterior and right posterior to the upper jaw.

The status of emergence of the permanent tooth was recorded in an examination chart specially designed for this study. Any part of the tooth emerging or erupting in the oral cavity was considered as an eruption of tooth (Heinrich-Weltzien et al., 2013). Any extracted permanent teeth were recorded as erupted (Ahmed and Al-Dahan, 2016). Since no radio-graphical examination was made, any congenital missing tooth was recorded as non-emerged (Ahmed and Al-Dahan, 2016).

2. Socioeconomic status assessment
The Socioeconomic status of the participants was determined using Fahmy modified index (Fahmy et al., 2015). This index was designed for evaluation of the social status of families, to be used in health research in Egypt. Data were collected by the examiner, using an interview questionnaire that included the following updated social Questions: (A) Mother’s education. (B) Father’s education. (C) Working
status of the mother. (D) Working status of the father. (E) Use of computer. (F) Per-capita income. (G) Family size. (H) Crowding index. (I) Proper sewage disposal. (J) Proper refuse disposal. The examiner asked the questions to one /or both of the parents of each child and filled the index as well, school children whom parents were not met, were telephoned interviewed.

The total score of the scale was 54, and according to the final score, the family was classified into: high, middle and low SES as the following: High ≥75% (40.5 points). Middle 50 to < 75 %(< 40.5 > 27 points). Low <50% (<27 points).

2.2. Statistical analysis

Data were collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software® 2016. The data collected were tabulated and analyzed by SPSS® (statistical package for social science) version 25 (Armonk, NY: IBM Corp) on IBM compatible computer. The data were tested for normality using Kolmogorov–Smirnov test, Shapiro–Wilk tests then two types of statistics were done: Descriptive statistics: According to the type of data qualitative represented as number and percentage, quantitative represented by mean ± SD.

2.3. Analytical statistics

Independent Student t-test: was used for comparison between two groups having quantitative variables with normal distribution (for parametric data). - Chi-square test (χ²): was used to study comparison and association between two qualitative variables. -Pearson's correlation: used to study correlation between two variables having normally distributed data. - A P-value of < 0.05 was considered statistically significant & <0.001 for high significant result for two tailed tests.

3. Results

The study sample consisted of 2000 children, aged from 5 to 13 years old. [1000 Egyptian children (477 males and 532 females) and 1000 Sudanese Nubian children (494 males and 506 females)]. Sample characteristics stratified by sex and age group are shown in table (1).

Socioeconomic status distribution among the whole sample revealed non-significant difference between males and females in all levels of socioeconomic status by using Chi square test as shown in table (2).

Socioeconomic status distribution among different Egyptian age groups revealed significant difference between different levels in all groups P<0.05 by using Chi square test. In all groups middle level revealed the highest percentage as it was 48.8, 54.2, 54.2, 47.4, 51.4, 42.4, 49.1 and 51.7 % for group I, II, III, IV, V, VI, VII and VIII respectively. Also Socioeconomic status distribution among different Sudanese Nubian groups revealed significant difference between different levels in all groups P<0.05 by using Chi square test. In all groups middle level revealed the highest percentage as it was 46.3, 51.2, 52.7, 66.7, 58.3, 51.2, 61 and 67.9 % for group I, II, III, IV, V, VI, VII and VIII respectively as shown in table (3).

The total number of emerged teeth in Egyptian children were higher in females than males in all groups with significant difference in groups III, IV, V, VI respectively by using independent t-test as shown in table (4).

The total number of emerged teeth in Sudanese Nubian children were higher in males than females in most groups with significant difference in groups I, V, VI, VII respectively by using independent t-test as shown in table (5).

The racial difference in the total number of emerged teeth between Egyptian children and Sudanese Nubian children were only significantly higher in Sudanese Nubian than Egyptian children in groups I and VIII by using independent t-test as shown in table (6).

The correlation between the number of emerged teeth and socioeconomic status in Egyptian children revealed a weak negative insignificant correlation between the number of emerged teeth and socioeconomic status, r= -0.056 as presented in figure (1).

The correlation between the number of emerged teeth and socioeconomic status in Sudanese Nubian children revealed a weak negative significant correlation between the number of emerged teeth and socioeconomic status, r= -0.101 as presented in figure (2).
Table 1: Sample characteristics stratified by sex and age groups

| Age Group | Egyptian children |  |  |  |  | Sudanese Nubian children |  |  |  |  |
|-----------|-------------------|---|---|---|---|--------------------------|---|---|---|---|
|           | Total (N=1000)    | Male | Female | P value | Total (N=1000) | Male | Female | P value |
| I (5<6)y  | 160               | 80  | 80  | 8  | 1.0 | 216               | 91  | 125 | 12.5 | 0.001*|
| II (6<7)y | 120               | 62  | 58  | 5.8 | 0.66 | 86               | 37  | 49  | 4.9  | 0.81  |
| III (7<8)y| 120               | 47  | 73  | 7.3 | 0.001* | 110             | 66  | 44  | 4.4  | 0.03* |
| IV (8<9)y | 133               | 65  | 68  | 6.8 | 0.71 | 96               | 47  | 49  | 4.9  | 0.96  |
| V (9<10)y | 140               | 54  | 86  | 8.6 | 0.001* | 108             | 37  | 71  | 7.1  | 0.001* |
| VI (10<11)y| 99                | 49  | 50  | 5   | 0.90 | 82               | 44  | 38  | 3.8  | 0.73  |
| VII (11<12)y| 108              | 52  | 56  | 5.6 | 0.47 | 118             | 71  | 47  | 4.7  | 0.004* |
| VIII (12<13)y| 120            | 69  | 51  | 5.1 | 0.02* | 184             | 100 | 84  | 8.4  | 0.09  |

Table 2: Socioeconomic status distribution stratified by sex

| Socioeconomic Status | Egyptian children |  |  |  |  | Sudanese Nubian children |  |  |  |  |
|----------------------|-------------------|---|---|---|---|--------------------------|---|---|---|---|
|                      | Low N=522         | Middle | High |  |  | Low N=108_b | Middle | High |  |  |
| Sex                  | Female N=115_a    | 265_b | 142_a |  |  | 108_b | 251_b | 147_a,b | 506 |
|                      | % 11.5% 26.5% 14.2% | 52.2% | 10.8% 25.1% 14.7% | 50.6% |  
|                      | Male N=109_a     | 237_a | 132_a | 478 | 59_b | 317_b | 118_a,b | 494 |
|                      | % 10.9% 23.7% 13.2% | 47.8% | 5.9% 31.7% 11.8% | 49.4% |  
| Total N=1000        | 224 | 502 | 274 | 1000 | 167 | 568 | 265 | 1000 |
|                      | % 22.4% 50.2% 27.4% | 100.0% | 16.7% 56.8% 26.5% | 100.0% |  

Counts with the same superscript letters are insignificantly different.
Table 3: Socioeconomic status distribution among different age groups:

| SES  | Total (N=1000) | Low  |   | Middle |   | High |   | P value | Total (N=1000) | Low  |   | Middle |   | High |   | P value |
|------|----------------|------|---|--------|---|------|---|---------|----------------|------|---|--------|---|------|---|---------|
|      |                | N    |%  | N      |%  | N    |%  |         |                | N    |%  | N      |%  | N    |%  |         |
| I    | 160            | 35 a |21.9| 78 b   |48.8| 47 a |29.4| 0.001*  | 216            | 43 a |19.9| 100 b  |46.3| 73 a |33.8| 0.001*  |
| II   | 120            | 18 a |15  | 65 b   |54.2| 37 c |30.8| 0.001*  | 86             | 24 a |19.9| 44 b   |51.2| 18 a |20.9| 0.001*  |
| III  | 120            | 22 a |18.3| 65 b   |54.2| 33 a |27.5| 0.001*  | 110            | 10 a |9.1  | 58 b   |52.7| 42 b |38.2| 0.001*  |
| IV   | 133            | 27 a |20.3| 63 b   |47.4| 47 b |35.3| 0.001*  | 96             | 8 a  |8.3  | 64 b   |66.7| 24 c |25  | 0.001*  |
| V    | 140            | 39 a |27.9| 72 b   |51.4| 29 c |20.7| 0.001*  | 108            | 22 a |20.4| 63 b   |58.3| 23 a |21.3| 0.001*  |
| VI   | 99             | 26 a |26.3| 42 b   |42.4| 31 c |31.3| 0.001*  | 82             | 9 a  |10.9| 42 b   |51.2| 31 b |37.8| 0.001*  |
| VII  | 108            | 20 a |18.5| 53 b   |49.1| 35 c |32.4| 0.001*  | 118            | 15 a |12.7| 72 b   |61  | 31 c |26.3| 0.001*  |
| VIII | 120            | 40 a |33.3| 62 b   |51.7| 18 c |15  | 0.001*  | 184            | 36 a |19.6| 125 b  |67.9| 23 b |12.5| 0.001*  |

Counts with the same superscript letters are insignificantly different.

Table 4: Sex differences in number of emerged teeth among Egyptian children

|      | Total  | Male  | Female |
|------|--------|-------|--------|
|      | No. of children | No. of emerged teeth | Mean no. of teeth | SD | No. of children | No. pf emerged teeth | Mean no. of teeth | SD | No. of children | No. of emerged teeth | Mean no. of teeth | SD | Sig.    |
| I    | 160    | 247   | 1.5    | 2.5  | 80         | 123      | 1.5    | 2.7  | 80         | 124      | 1.6    | 2.3  | 0.324   |
| II   | 120    | 593   | 4.9    | 3.5  | 62         | 312      | 5      | 3.5  | 58         | 281      | 4.8    | 3.5  | 0.712   |
| III  | 120    | 1035  | 8.6    | 3.2  | 47         | 364      | 7.7    | 2.7  | 73         | 671      | 9.2    | 3.4  | 0.015*  |
| IV   | 133    | 1439  | 10.9   | 2.7  | 65         | 699      | 10.9   | 2.4  | 68         | 740      | 10.9   | 3.1  | 0.031*  |
| V    | 140    | 1820  | 13.1   | 4.1  | 54         | 635      | 12     | 2.9  | 86         | 1185     | 13.9   | 4.5  | 0.006*  |
| VI   | 99     | 1635  | 16.5   | 5.2  | 49         | 756      | 15.4   | 3.9  | 50         | 879      | 17.6   | 5.9  | 0.038*  |
| VII  | 108    | 2237  | 20.7   | 5.5  | 52         | 1035     | 19.9   | 5.3  | 56         | 1202     | 21.5   | 5.6  | 0.141   |
| VIII | 120    | 2838  | 23.7   | 5.1  | 69         | 1602     | 23.2   | 4.9  | 51         | 1236     | 24.2   | 5.1  | 0.277   |
Table 5: Sex differences in number of emerged teeth among Sudanese Nubian children

| Group | Total No. of children | No. pf emerged teeth | Mean no. of teeth | SD | No. of children | No. pf emerged teeth | Mean no. of teeth | SD | No. of children | No. pf emerged teeth | Mean no. of teeth | SD | Sig.  |
|-------|-----------------------|----------------------|------------------|----|----------------|----------------------|------------------|----|----------------|----------------------|------------------|----|-------|
| I     | 216                   | 609                  | 2.9              | 3.5| 91             | 418                  | 4.6              | 3.5| 125           | 191                  | 1.5              | 2.8 | 0.001* |
| II    | 86                    | 430                  | 5                | 3.9| 62             | 178                  | 4.9              | 3.3| 49            | 248                  | 5.1              | 4.2 | 0.87   |
| III   | 110                   | 905                  | 8.2              | 2.2| 47             | 531                  | 8                | 2  | 44            | 374                  | 8.5              | 2.6 | 0.25   |
| IV    | 96                    | 1025                 | 10.7             | 3.3| 65             | 504                  | 10.7             | 3  | 49            | 521                  | 10.6             | 3.5 | 0.89   |
| V     | 108                   | 1462                 | 13.5             | 5.1| 54             | 447                  | 12.1             | 2.2| 86            | 1015                 | 14.3             | 4.6 | 0.006* |
| VI    | 82                    | 1383                 | 17               | 5.1| 49             | 682                  | 15.5             | 4.9| 50            | 701                  | 18.9             | 4.6 | 0.002* |
| VII   | 118                   | 2525                 | 21.4             | 5.2| 47             | 1423                 | 20               | 5.2| 71            | 1102                 | 23.4             | 4.6 | 0.001* |
| VIII  | 184                   | 4798                 | 26.1             | 3.2| 69             | 2569                 | 25.7             | 3.5| 51            | 2229                 | 26.5             | 2.8 | 0.075 |

Table 6: Race differences in number of emerged teeth between Egyptian and Sudanese Nubian children

| Age group | Total no. of emerged teeth | Egyptian Mean | SD | Sudanese Nubian Mean | SD | p-value  |
|-----------|-----------------------------|---------------|----|----------------------|----|----------|
| I         | 247                         | 1.5           | 2.5| 609                  | 2.9| 3.5      | 0.001* |
| II        | 593                         | 4.9           | 3.5| 430                  | 5  | 3.9      | 0.91   |
| III       | 1035                        | 8.6           | 3.2| 905                  | 8.2| 2.2      | 0.309  |
| IV        | 1439                        | 10.9          | 2.7| 1025                 | 10.7| 3.3      | 0.567  |
| V         | 1820                        | 13.1          | 4.1| 1462                 | 13.5| 5.1      | 0.506  |
| VI        | 1635                        | 16.5          | 5.2| 1383                 | 17 | 5.1      | 0.468  |
| VII       | 2237                        | 20.7          | 5.5| 2525                 | 21.4| 5.2      | 0.337  |
| VIII      | 2838                        | 23.7          | 5.1| 4798                 | 26.1| 3.2      | 0.001* |
4. Discussion

Permanent teeth are biological markers of maturity and their emergence is an important milestone in a child's development. Many biological and environmental factors affect the timing and pace of emergence of permanent teeth (Subramaniam and Pagadala, 2020).

Permanent teeth emergence in the oral cavity occurs over a broad chronological age range and is influenced by various factors like genetics, sex, nutrition, preterm birth, socioeconomic factors, height and weight, craniofacial morphology, hormonal factors and systemic diseases. Studies have also reported differences in the emergence of permanent teeth between ethnic groups, nutritional factors, and congenital abnormalities such as supernumerary teeth, Down’s syndrome, cleidocranial dysplasia and environmental trends (Anusha et al., 2018; Alshukairi 2019; Choukroune 2017).

This study was designed to assess the correlation between the socioeconomic status as factor affecting the number of permanent teeth emerged, also to assess sex and racial differences in permanent teeth emergence.
Tooth eruption can be divided into embryological tooth eruption and clinical eruption (emergence). Clinical tooth eruption, which refers to the appearance of some parts of tooth in question above the gingival surface. If a tooth is to be considered as “erupted” only if it is in occlusion, it would result in an overestimation in the eruption age of that particular tooth. Therefore, in this study, a tooth was considered to be erupted if any part of the tooth had penetrated through the gingiva and was visible in the oral cavity (Subramaniam and Pagadala, 2020).

In this study Egyptian Females showed higher number of emerged teeth than males and the total number of emerged teeth was 12.2 teeth/child in the total sample (excluding the third molars). The mean total number of teeth per child increased with age and by the age of 13 years almost all permanent teeth were emerged. Among the majority of age groups, the mean total number of emerged teeth was higher in females than males with a significant difference in groups III, IV, V and VI (p<0.05). Females had more teeth than males by an average of about 2 teeth per child (Average factor = Females mean total number of teeth per child – Males mean total number of teeth per child = 13.1 – 11.1 = 2 teeth/child). These findings show that females had earlier teeth emergence times than males and these findings go with other research findings from Egypt (Abd El-Hakam et al., 2015; Azzawi et al., 2016; Darwish et al., 2016; Elkhatab et al., 2021). and from around the world like, India (Gaur et al., 2011), Lithuanian (Almonaitiene, and Tutkuviene, 2012), Filipino (Heinrich-Weltzien et al., 2013), Iraq (Ahmed and Al-Dahan, 2016, Noori et al., 2015), Czech (Šindelárová et al., 2017), and China (Zhang et al., 2020). This could be explained by the fact that girls exhibit earlier physical development than boys.

Other studies reported opposite findings, and the average number of emergence of permanent teeth in males was greater than in females and, hence earlier tooth emergence than females (Lailasari, et al., 2018; Kutesa et al., 2013; Kariya et al., 2018). While a few studies had equally shown no gender difference, in Egypt (Soliman et al., 2011), Russia (Khatskevich, and Bogomolova, 2004), German (Friedrich et al., 2008), and in Saudi Arabia (Khan, 2011).

In contrast, in this study Sudanese Nubian males showed higher number of emerged teeth than females and the total number of emerged teeth was 13.1 teeth/child in the total sample (excluding the third molars). With increasing age, the mean total number of teeth present were also increased as more teeth emerged in all age groups, and it was statistically significant in groups I, V, VI, VII. Males had more teeth than females by an average of about 1.1 teeth per child (Average factor = males mean total number of teeth per child – females mean total number of teeth per child = 13.7 – 12.6 = 1.1 teeth/child). These findings show that males had earlier tooth emergence than females. These findings were supported by another study conducted in Sudan (Motaz et al., 2020).

Sudanese Nubian children had more number of emerged teeth than Egyptian children, although it was not statistically significant except in groups I and VII. This means that Sudanese Nubian children showed racial difference where they had earlier teeth emergence than Egyptian children. This is in accordance with other studies in Nigeria and United States, which stated that African lineage has earlier teeth emergence than Caucasian lineage (Oziegbie et al., 2008, Warren et al., 2016).

Population changes affect almost all components of social and economic life from a macro perspective down to the community level, and ultimately, the family and individual units. Since the last scaling of socioeconomic status by Fahmy et al. (2015), no updating effort was done till the present study was conducted, therefore it was used in this study.

Previous studies reported earlier tooth emergence among children of higher socioeconomic background as compared to those from a low socioeconomic status. The reported relationship has been attributed to the fact that the socioeconomic status of individuals could be used as an indicator of their nutritional status. It is stipulated that good socioeconomic status would indicate access to adequate nutrition and thus have an effect on growth and development (Kaur et al., 2010; Fatmasari et al., 2019; Carneiro et al., 2017).

In contrary our results showed a negative correlation between socioeconomic status and permanent teeth emergence in both Egyptian and Sudanese Nubian children. This means that Children from low socioeconomic background have earlier permanent teeth emergence than children from high background, these results were in agreement with another study conducted by Darwish et al. (2016) in Egypt. She attributed that result, as children from low socioeconomic status are more subjected to sun
rays and consequently Vit. D than children from high socioeconomic status and, hence early teeth emergence than children from high socioeconomic status.

Limitations of this study
One of the challenges faced during the performance of the present study, was the differentiation between congenitally missing teeth or impacted teeth and non-emerged teeth, as a result of not using radiographs, radiographic method is not found ethical, and it is not possible in cross-sectional studies. Another challenge faced, was data collection during the pandemic Covid-19 virus.

Conflict of interests
There was no conflict of interests in this study.

4. Conclusion
There is a relationship between socioeconomic status and the number of permanent teeth emerged in Egyptian and Sudanese Nubian children aged 5 to 13 years old. The higher the socioeconomic status of a child, the less number of permanent teeth emerged. It is also concluded that sex and race influence emergence of permanent teeth.

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