

## Pattern of Caries and Gingivitis in a Selected Population of Schoolchildren Aged 9 to 11 Years

(Corak Kejadian Karies dan Penyakit Gusi dalam Kalangan Populasi Kanak-kanak Sekolah Terpilih Berumur 9 hingga 11 Tahun)

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### ABSTRACT

*The objectives of this study were to determine the prevalence of caries and gingivitis in a selected population of schoolchildren and to examine the relationship between prevalence of the diseases with their oral health behaviours. A total of 39 subjects, aged nine to 11 years, from 147 schoolchildren of a private school in Selangor, Malaysia were examined by two calibrated examiners trained in their own field. The subjects were interviewed using structured questionnaires. Erupted first permanent molars and permanent anterior teeth were examined. Dental caries, Plaque Score and Gingival Index were recorded. Descriptive statistics using frequency distribution were used to analyse the data. Forty-one percent of the subjects presented with more than 75% of total plaque accumulation. Prevalence of caries and gingivitis for the subject population was 18.0% and 31.0%, respectively. Caries was found on both the smooth (buccal/lingual/palatal) and occlusal surfaces. Gingivitis, diagnosed around 31.6% of teeth, was found more on the incisors (16.9%) than molars (14.7%). A relatively higher distribution of gingivitis was found on labial aspect of the incisors (5.5%) and palatal/lingual aspect of the molars (4.7%). The prevalence of caries and gingivitis in this selected population was low. Certain dentition sites were more susceptible to dental caries and gingivitis. Good toothbrushing habits and regular visits to the dentists do not guarantee the efficacy of plaque removal.*

*Keywords: Caries pattern; gingivitis; oral health behaviour; plaque; toothbrushing*

### ABSTRAK

*Objektif kajian ini adalah untuk menentukan kadar kejadian karies dan penyakit gusi dalam kalangan populasi pelajar sekolah yang telah dikenal pasti dan mengkaji hubungan kait antara kadar kejadian penyakit-penyakit tersebut dengan tabiat penjagaan kesihatan mulut. Sebanyak 39 subjek daripada 147 pelajar sebuah sekolah rendah persendirian di Selangor, Malaysia yang berumur antara 9 dan 11 tahun telah diperiksa oleh dua orang penyelidik yang telah dikalibrasi dan terlatih dalam bidang masing-masing. Subjek ditemu bual menggunakan borang kaji selidik. Gigi molar kekal pertama dan gigi kekal anterior yang telah tumbuh sempurna diperiksa. Karies, skor plak dan indeks kesihatan gusi direkodkan. Statistik deskriptif menggunakan taburan frekuensi digunakan untuk menganalisis pengalaman karies, skor plak dan indeks kesihatan gusi. Empat puluh satu peratus subjek mempunyai plak melebihi 75% jumlah keseluruhan pengumpulan plak pada permukaan gigi yang direkodkan. Kadar kejadian karies bagi keseluruhan subjek adalah 18.0% manakala kadar kejadian gingivitis adalah 31.0%. Karies direkodkan melibatkan permukaan licin (bukal/lingual/palatal) dan oklusal. Sebanyak 31.6% gusi mengalami gingivitis dengan gigi insisor (16.9%) mendahului berbanding gigi geraham (14.7%). Secara relatifnya, taburan gingivitis lebih tinggi pada aspek labial gigi insisor (5.5%) dan aspek palatal/lingual gigi geraham (4.7%). Kesimpulannya, kadar kejadian karies dan gingivitis dalam populasi terpilih ini adalah rendah. Seseengah kawasan gigi lebih cenderung kepada karies dan gingivitis. Tabiat memberus gigi yang baik dan pemeriksaan gigi secara berkala didapati bukan penentu kepada keberkesanan membersihkan plak daripada permukaan gigi.*

*Kata kunci: Corak karies; gingivitis; memberus gigi; plak; tabiat kesihatan mulut*

### INTRODUCTION

There is a general agreement that a marked reduction in caries prevalence has occurred among children in most developed countries in recent decades; changes were reported in caries epidemiology, including the pattern of caries presentation intra-orally (Marthaler 2004). In spite of this, it is still the most common disease in children with certain populations being at high risk. In Malaysia, albeit

declining trend in caries prevalence in schoolchildren, the latest National Oral Health Survey showed an increased caries severity in young children within the high caries risk group (NOHSS 2007).

Dental plaque is the main cause of caries as well as gingivitis (Kinane et al. 2001). In a susceptible individual, gingivitis may progress into periodontitis. Susceptibility to dental caries and gingivitis can be associated with common

risk factors such as toothbrushing habits, socio-economic status and dental attendance (Kallio 2001; Oliveria et al. 2000).

The Dental Division, Ministry of Health developed National Oral Health Plan (NOHP 2010), that set a target of a 60% caries free permanent dentition and 95% healthy periodontium for 12 year-old schoolchildren. In order to achieve these goals, the Health Promotion Unit was set up to ensure that people from all age groups have their own tooth brushes and perform toothbrushing at least once a day (NOHP 2006).

Studies have shown that oral health behaviour which includes toothbrushing habits and visits to dentists is strongly influenced by individual socioeconomic background (Smyth et al. 2007). However, others have shown conflicting evidence regarding association of child oral health and family socio-economic background (Maes et al. 2006; Matilla et al. 2000).

Appropriate oral health behaviour has been proven to promote good oral health and vice versa (Kiwauka et al. 2004; Oliveria et al. 2000). Claydon (2008) and van der Weijden and Hioe (2005) have suggested that effective toothbrushing is important in plaque removal. Children aged 9 to 11 years old should have acquired acceptable dexterity to perform satisfactory oral hygiene, unaided. However, the children need to acquire appropriate toothbrushing skills in order to achieve effective plaque control and toothbrushing skills are closely related to a proper technique.

The aim of this study was to determine the prevalence and pattern of dental caries and gingivitis and to examine the association between prevalence of the diseases and their dental habits which consist of toothbrushing frequency and dental attendance in a selected population of schoolchildren.

#### MATERIALS AND METHODS

Prior to the commencement of this study, ethical approval from the Medical Ethics Committee, Faculty of Dentistry University of Malaya (DF CD1004/0020(P)) was obtained. This study was carried out in January 2010 at a private school in Selangor, Malaysia. A total of 139 schoolchildren were examined, however only 39 schoolchildren aged between 9 and 11 years fulfilled the inclusion criteria. The inclusion criteria set for the study were as follows: Schoolchildren who are medically fit and those who presented with at least eight fully-erupted permanent teeth.

Written informed consents were obtained from the parents. All children involved in the study and their parents were aware of the fact that the participants could withdraw from the study at any time.

A face to face interview of the subjects using a structured questionnaire constructed in English and Malay was followed by an oral examination. The interview obtained information on socio-demographic background and dental habits which consist of toothbrushing frequencies and dental attendance.

Two calibrated examiners trained in their own fields (caries diagnosis and periodontology) carried out the clinical examinations for all subjects. One examiner (LAS) carried out clinical examination for caries status and another examiner (SHS) carried out clinical examination for Plaque Score (O'Leary et al. 1972) and Gingival Index (Løe & Silness 1963).

Each subject was seated on a school chair facing the source of daylight. Intra-oral examination was carried out using a torch light. Dental caries was diagnosed by visual examination with the aid of a dental probe and a disposable dental mirror. Teeth were dried and cleaned with gauze if the presence of debris interfered with examination of the tooth surface.

William's periodontal probe was used for assessment of gingivitis. Plaque accumulation on the tooth surface was evaluated using dichotomous plaque score based on O'Leary et al. (1972) and gingival presentation was assessed using Løe and Silness Gingival Index (1963). Plaque score was categorised as follows:  $\leq 25\%$  (good), 26% - 50% (fair), 51% - 75% (poor) and  $>75\%$  (very poor) whereas gingival index was characterised as follows: 0 (absence of gingival changes and bleeding = healthy gingiva), 1 (slight change in colour, slight oedema, absence of bleeding on probing = mild inflammation), 2 (redness, oedema, shiny, presence of bleeding and probing = moderate inflammation) and 3 (marked redness and oedema, tendency to spontaneously bleed = severe inflammation). Gingivitis was defined as presence of gingival changes with bleeding on probing.

In this study only fully erupted first permanent molars (FPMS) and permanent anterior teeth were examined; full eruption of these teeth were indicated by the incisal edges of anteriors and occlusal surfaces of FPMS having reached the position at which they will remain throughout their presence in the dental arch. The data obtained were categorised to subject level, tooth level and tooth surfaces/sites level. A total of 468 teeth; 312 incisors and 156 molars were examined for caries and gingivitis at tooth level and at tooth-surfaces/sites level; 1996 surfaces were assessed for caries distribution while 936 sites were assessed for gingivitis.

#### STATISTICAL METHODS

The data collected were analysed using a standard statistical software package (SPSS 19.0, SPSS, USA). Descriptive statistics using frequency distribution were calculated for caries experience, gingivitis, plaque score and gingival index. The Spearman rho correlation test was used to examine the association between prevalence of dental caries and gingivitis with dental habits (toothbrushing frequency and dental attendance).

#### RESULTS

Screening was done on all children attended the school ( $n=139$ ). A total of 39 schoolchildren who fulfilled the inclusion criteria were selected for the study. The subjects

comprised of twenty males (51.3%) and 19 females (48.7%) and were all of Malay ethnicity. Examiner calibration demonstrated intra-examiner reproducibility of 0.72 for the caries assessment and 0.63 for plaque score and gingival index assessment, which represent substantial agreement (Landis & Koch 1977).

#### QUESTIONNAIRE

The findings from the questionnaires are summarised in Table 1. It was presented that the schoolchildren were drawn from a high socio-economic background as defined by total household income of more than RM10,000 per month.

Results on toothbrushing frequency showed that 28 subjects (71.8%) brushed twice daily, nine subjects (23.1%) brushed more than twice a day and only two subjects (5.1%) brushed once a day. There was no difference in daily frequency of toothbrushing between the male and female subjects.

Fluoridated toothpastes were used by 38.5% of the subjects, whereas 46.2% used non-fluoridated toothpaste. The remainder (15.3%) were not aware of the type of toothpaste used. More than half of the respondents (64.1%) reported to have received dental treatment before while 35.9% had never experienced dental treatment.

#### PLAQUE SCORE

Nearly half of the subjects (41.0%) presented with more than 75.0% of total plaque accumulation. Plaque scores

of 51.0 – 75.0% were seen in 38.5% of the subjects, 17.9% of the subjects presented with 26.0 – 50.0% plaque accumulation. Only one subject had less than 25.0% of plaque score (Table 1).

Figures 1(a) and 1(b) show the plaque accumulation by tooth-type. Similar pattern of plaque accumulation was seen for incisors and molars of both genders. More than 75% of the plaque accumulation present on the incisors was found in 41% of the male subjects and 35.9% in female subjects. Whilst in the molars it was shown in 38.5% and 33% of the male and female subjects, respectively.

At tooth surface level relatively higher plaque accumulation was found on palatal/lingual surfaces of the incisors compared with other tooth surfaces in either the incisors or molars. Out of 936 surfaces assessed 71.6% were noted to have plaque (Table 2).

#### PREVALENCE OF CARIES

At subject level, the prevalence of caries was 18.0% (7 out of 39) (Figure 2(a)) while according to the tooth-type, 98.5% of the subjects were caries free. As would be expected for this age group in the mixed dentition; it was found that the permanent molar teeth showed more caries than the permanent incisors (Table 3). The distribution of caries according to the surfaces showed 99.3% of the 1996 surfaces was caries free, 0.2% was carious and 0.5% was filled. Caries was found on the smooth (buccal/lingual/palatal) as well as on the occlusal surfaces and none was detected on the approximal surfaces (Table 4).

TABLE 1. Socio demographic data and summary of oral health behaviour

| Variable                  | <i>n</i> | Percentage |
|---------------------------|----------|------------|
| Demographic               |          |            |
| Urban                     | 39       | 100%       |
| Socioeconomic status      |          |            |
| High                      | 39       | 100%       |
| Gender                    |          |            |
| Male                      | 20       | 51.3%      |
| Female                    | 19       | 48.7%      |
| Toothbrushing frequency   |          |            |
| Once/ day                 | 2        | 5.1%       |
| Twice/ day                | 28       | 71.8%      |
| More than twice/ day      | 9        | 23.1%      |
| Use of toothpaste         |          |            |
| Fluoridated               | 15       | 38.5%      |
| Non-fluoridated           | 18       | 46.2%      |
| Others                    | 6        | 15.3%      |
| Dental treatment received |          |            |
| No                        | 14       | 35.9%      |
| Yes                       | 25       | 64.1%      |
| Plaque score              |          |            |
| ≤25%                      | 1        | 2.6%       |
| 26% - 50%                 | 7        | 17.9%      |
| 51% - 75%                 | 15       | 38.5%      |
| >75%                      | 16       | 41.0%      |

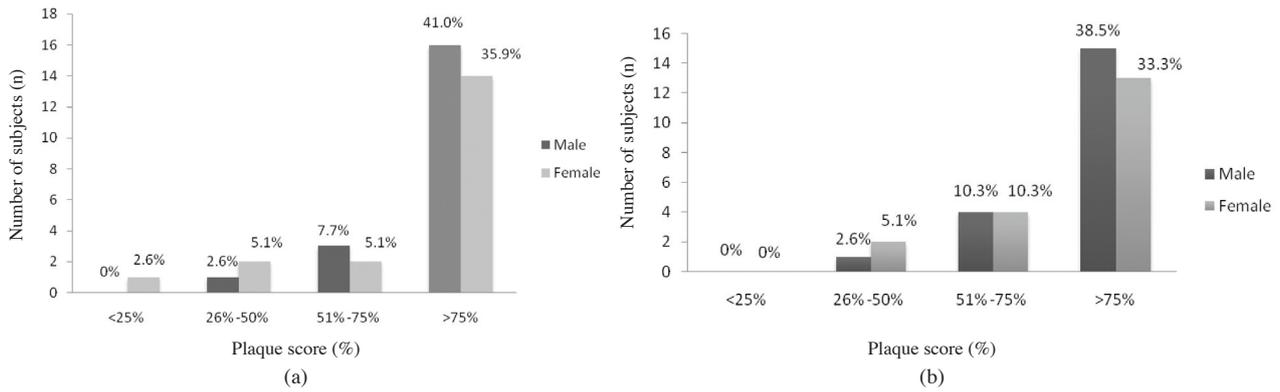


FIGURE 1(a). Plaque accumulation by tooth-type (incisors) and (b) plaque accumulation by tooth-type (molars)

TABLE 2. Accumulation of plaque at tooth surface level

| Plaque | Incisors               |         |                           |         | Molars          |         |                           |         | All teeth    |         |
|--------|------------------------|---------|---------------------------|---------|-----------------|---------|---------------------------|---------|--------------|---------|
|        | Labial surfaces        |         | Palatal/ Lingual surfaces |         | Buccal surfaces |         | Palatal/ Lingual surfaces |         | All surfaces |         |
|        | Number of surfaces (n) |         |                           |         |                 |         |                           |         |              |         |
|        | Absent                 | Present | Absent                    | Present | Absent          | Present | Absent                    | Present | Absent       | Present |
| Male   | 61                     | 99      | 51                        | 109     | 13              | 67      | 6                         | 74      | 131          | 349     |
| Female | 70                     | 82      | 44                        | 108     | 12              | 64      | 9                         | 67      | 135          | 321     |
| Total  | 131                    | 181     | 95                        | 217     | 25              | 131     | 15                        | 141     | 266          | 670     |
|        | (14.0%)                | (19.3%) | (10.2%)                   | (23.2%) | (2.7%)          | (14.0%) | (1.6%)                    | (15.1%) | (28.4%)      | (71.6%) |

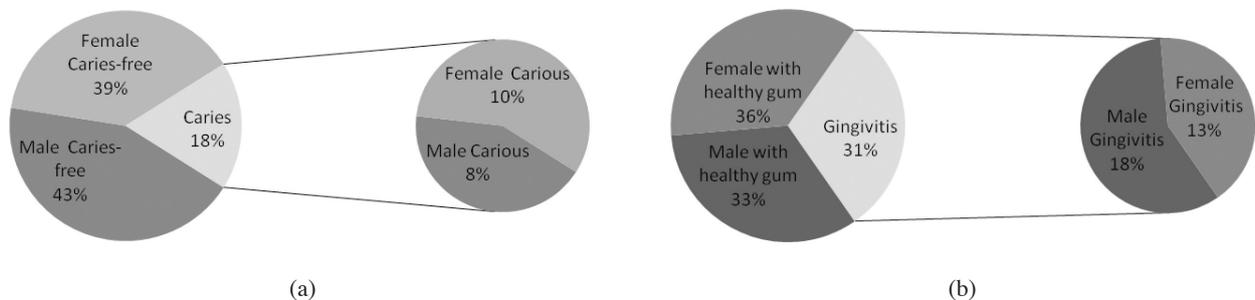


FIGURE 2(a). Caries prevalence by gender and (b) prevalence of gingivitis

TABLE 3. Distribution of caries according to tooth-type

|             | Incisors (n=312) | Molars (n=156) | Total (n=468) |
|-------------|------------------|----------------|---------------|
| Carious     | 1 (0.2%)         | 6 (1.3%)       | 7 (1.5%)      |
| Caries-free | 311 (66.5%)      | 150 (32.0%)    | 461 (98.5%)   |

#### PREVALENCE OF GINGIVITIS

Prevalence of gingivitis was 31.0% at subject level (Figure 2(b)). Distribution of gingivitis according to tooth-type showed that 31.6% of the teeth had gingivitis, which interestingly, was found more on the incisors (16.9%) than molars (14.7%) (Table 5). Examination at tooth sites revealed that 29.0% of the gingiva on buccal sites had sign of inflammation without bleeding whereas on the palatal/

lingual sites was 24.5%. Increased prevalence of inflamed gingiva with bleeding on the buccal sites compared with the palatal sites was 9.7% and 8.7%, respectively (Figure 3). Generally, percentage of gingivitis at sites level was quite low in this group of subjects (Table 6). Of all sites examined, relatively higher distribution of gingivitis was found on labial aspect of the incisors (5.5%) and palatal/lingual aspect of the molars (4.7%). Only 3.4% of sites

TABLE 4. Distribution of caries according to tooth surfaces

|        | Smooth surface *       |             |             | Approximal surface |           |             | Occlusal surface |             |             | All surfaces    |             |              |
|--------|------------------------|-------------|-------------|--------------------|-----------|-------------|------------------|-------------|-------------|-----------------|-------------|--------------|
|        | Number of surfaces (n) |             |             |                    |           |             |                  |             |             | Sound           | Caries      | Filled       |
|        | Sound                  | Caries      | Filled      | Sound              | Caries    | Filled      | Sound            | Caries      | Filled      |                 |             |              |
| Male   | 465                    | 1           | 2           | 466                | 0         | 2           | 76               | 1           | 2           | 1007            | 2           | 7            |
| Female | 450                    | 0           | 2           | 452                | 0         | 0           | 71               | 0           | 2           | 973             | 0           | 7            |
| Total  | 915<br>(45.9%)         | 1<br>(0.1%) | 4<br>(0.2%) | 918<br>(46.0%)     | 0<br>(0%) | 2<br>(0.1%) | 147<br>(7.4%)    | 1<br>(0.1%) | 4<br>(0.2%) | 1980<br>(99.3%) | 2<br>(0.2%) | 14<br>(0.5%) |

\*smooth surface on buccal/lingual/ palatal

TABLE 5. Distribution of gingivitis according to tooth-type

| Gingivitis | Incisors       |              |                |              | Molars        |               | All teeth      |                |
|------------|----------------|--------------|----------------|--------------|---------------|---------------|----------------|----------------|
|            | Central        |              | Lateral        |              | Absent        | Present       | Absent         | Present        |
|            | Absent         | Present      | Absent         | Present      |               |               |                |                |
| Male       | 52             | 28           | 61             | 19           | 42            | 38            | 155<br>(33.1%) | 85<br>(18.1%)  |
| Female     | 60             | 16           | 60             | 16           | 45            | 31            | 165<br>(35.3%) | 63<br>(13.5%)  |
| Total      | 112<br>(23.9%) | 44<br>(9.4%) | 121<br>(25.9%) | 35<br>(7.5%) | 87<br>(18.6%) | 69<br>(14.7%) | 320<br>(68.4%) | 148<br>(31.6%) |

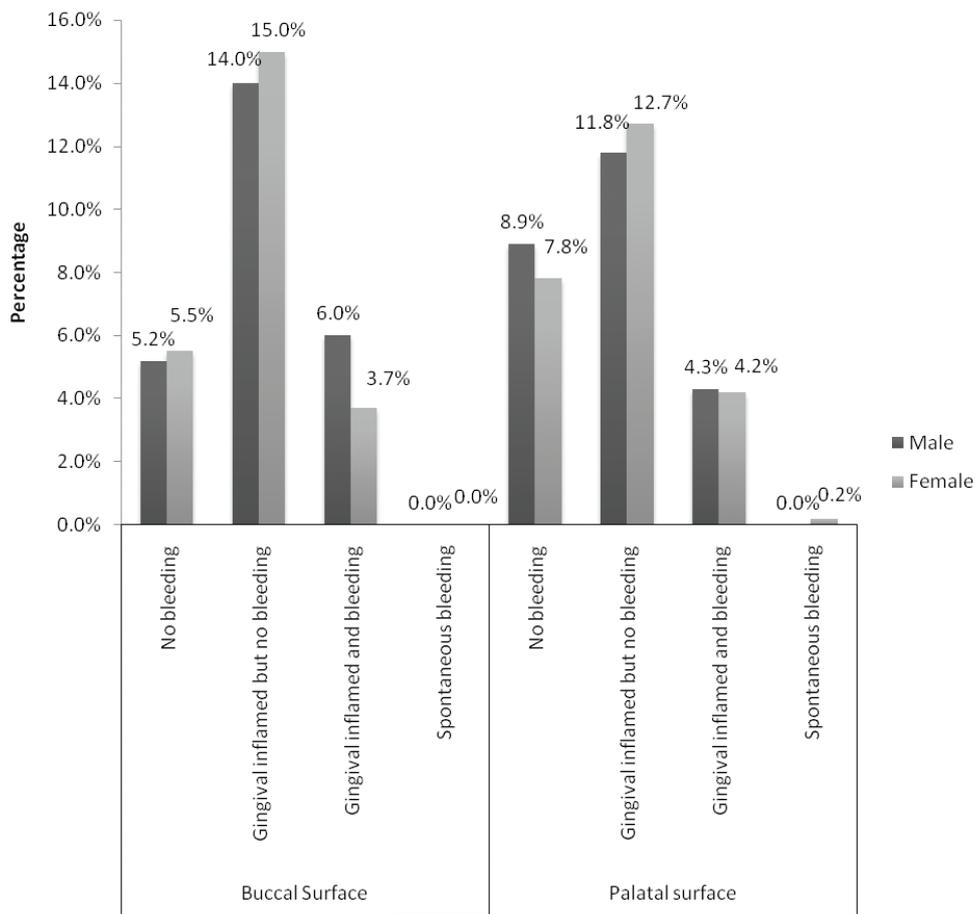


FIGURE 3. Distribution of gingivitis according to tooth sites

had gingivitis on palatal/ lingual aspect of the incisors and buccal aspect of the molars (Table 6).

**Association** There was a weak association between visits to dentist and dental caries ( $r=0.189$ ) and no association between visits to dentist and gingivitis ( $r=0.000$ ). Similarly, there were no association between brushing frequency and caries ( $r=0.094$ ) but there was a tendency towards negative correlation between brushing frequency and gingivitis ( $r=-0.104$ ,  $p=0.53$ ) (Table 7).

## DISCUSSION

The subjects from this study came from high level of socio-economic background and they reported positive oral health behaviour which includes good toothbrushing habits and regular visits to dentists. However, the results from the current study contradict those from several other studies that suggested the reported frequency of toothbrushing and use of fluoride are associated with decreased dental caries and general oral health (Löe 2000; Uribe 2006; Vanobbergen et al. 2001).

The present study found that the subjects had high levels of plaque and gingivitis even though most of them claimed to brush at least twice a day. This may be due to false positive responses by the schoolchildren in an attempt to give good impression to the examiner. Otherwise, it may have been due to improper brushing technique, which is in agreement with the hypothesis made by Wong et al. (2001) in a 12-year old Chinese population. Findings from the present study showed that almost half (46.2%) of the subjects did not use fluoridated toothpaste. In spite of that, caries prevalence was considerably low. As stated by

Claydon (2008), it is highly established that toothbrushing is an effective method for plaque removal. However, its effectiveness may not be achieved without the use of appropriate technique. As highlighted by Makuch et al. (2011), most studies focused only on toothpaste materials and brushing frequencies but not the technique.

In the present study, the prevalence of caries and gingivitis in the selected population of schoolchildren aged 9 to 11 were 18.0% and 31.0%, respectively. Lower caries prevalence in this group may be related to their regular dental visits and socio-economic background, which places them into low caries risk category. Gingivitis showed higher prevalence as compared with that of caries. This may be associated with high plaque scores being in the mixed dentition phase, a finding which is in agreement with Ramberg et al. (1994) who concluded that visible amount of plaque found in mixed dentition subjects resulted with gingival changes.

Findings from this study also showed that in this age group the posterior teeth were more susceptible to caries compared with the anterior teeth while at the tooth surface level; occlusal surfaces were more susceptible to caries compared with other surfaces. These are in agreement with other studies (Batchelor & Sheiham 2004; Hopcraft & Morgan 2006), although to be expected in this age group in the early mixed dentition. It is well accepted that in children caries presents most commonly in the pits and fissures. Hannigan et al. (2000) suggested that information on the site-specific dental caries pattern could guide clinicians in proper planning of preventive measures according to the caries risk of specific surfaces. Preventive approaches in oral health care can benefit those children who struggle with their plaque control. These approaches include use

TABLE 6. Distribution of gingivitis according to surfaces

|                        | Incisors        |            |                           |            | Molars          |            |                           |            | All teeth    |            |
|------------------------|-----------------|------------|---------------------------|------------|-----------------|------------|---------------------------|------------|--------------|------------|
|                        | Labial surfaces |            | Palatal/ Lingual surfaces |            | Buccal surfaces |            | Palatal/ Lingual surfaces |            | All surfaces |            |
| Number of surfaces (n) |                 |            |                           |            |                 |            |                           |            |              |            |
|                        | Healthy         | Gingivitis | Healthy                   | Gingivitis | Healthy         | Gingivitis | Healthy                   | Gingivitis | Healthy      | Gingivitis |
| Male                   | 125             | 35         | 147                       | 13         | 63              | 17         | 55                        | 25         | 390          | 90         |
| Female                 | 136             | 16         | 133                       | 19         | 61              | 15         | 57                        | 19         | 387          | 69         |
| Total                  | 261             | 51         | 280                       | 32         | 124             | 32         | 112                       | 44         | 777          | 159        |
|                        | (27.9%)         | (5.5%)     | (30.0%)                   | (3.4%)     | (13.3%)         | (3.4%)     | (12%)                     | (4.7%)     | (83.2%)      | (17%)      |

TABLE 7. Association between caries and gingivitis with dental attitudes

|                   | Caries                     | Gingivitis                  |
|-------------------|----------------------------|-----------------------------|
| Brushing          | $r = 0.094$<br>$p = 0.568$ | $r = -0.104$<br>$p = 0.530$ |
| Visits to dentist | $r = 0.189$<br>$p = 0.249$ | $r = 0.000$<br>$p = 1.000$  |

Spearman rho correlation test; significant level at  $p < 0.05$

of fluoride, application of fissure sealant on susceptible surfaces, dietary advice and oral hygiene instruction.

In the present study, the prevalence of gingivitis was found to be relatively similar in molar and incisor regions. Furthermore, the prevalence of gingivitis based on specific sites showed a greater occurrence of gingivitis associated with both molars and incisors on the palatal/lingual surface and labial surfaces respectively. Ineffective toothbrushing among the children may be attributed to the failure to clean the cervical area of upper and lower incisors or to spend sufficient time during brushing.

Several studies comparing the primary dentition, mixed dentition and permanent dentition in schoolchildren and older subjects showed variable results in susceptibility to gingivitis (Matsson 1978; Matsson & Goldberg 1985, 1986). A study by Matsson in 1978 found an increased tendency to gingival bleeding in posterior teeth of adults and schoolchildren regardless of the type of dentition. This contradicts our findings that showed higher prevalence of gingivitis around incisors. However, another study by the same author showed that established gingivitis with gingival index score 2 and 3 was found more in primary teeth than in permanent teeth in schoolchildren with a mixed dentition (Matsson 1993). Results of the present study proved that it is also site-related in children in the mixed dentition.

This study showed that toothbrushing technique may have a contributory effect in causing gingivitis although based on a small number of subjects. In spite of established evidence published on toothbrushing, no study so far has reported prevalence of caries and gingivitis based on tooth type and surface type in permanent teeth of children in mixed dentitions.

#### CONCLUSIONS

Within the limitations of this study, it can be concluded that the prevalence of caries and gingivitis in this selected population of schoolchildren aged 9 to 11 years, from a relatively affluent background, was low. Certain sites in the dentition were more susceptible to dental caries and gingivitis. Reported good toothbrushing habits and regular visits to the dentists, did not guarantee the efficacy of plaque removal.

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