

# Risk Indicators of Aggressive Periodontitis in a Jordanian Population

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Aggressive periodontitis (AP) is a distinct type of periodontitis previously termed early-onset periodontitis (EOP). Risk factors of AP are numerous but have not been studied in Jordanian adults. The aims of this study were to investigate the relationship between a number of risk indicators and AP, and to compare risk indicators of aggressive and chronic periodontitis (CP). The sample consisted of 195 patients (109 AP and 86 CP patients) attending Jordan University of Science and Technology (JUST) Dental Teaching Centre. Approximately 75% of subjects with AP were females and 25% were males. The majority of AP patients were  $\geq 35$  years of age, not working, had a family income  $< 625$  Euro/month ( $< 500$  JD/month), lived in rural areas, and had completed secondary education only. There was a statistically significant difference ( $p < 0.05$ ) between AP and CP patients with regard to age, frequency and duration of brushing, and to type, quantity and duration of smoking. Approximately 61% of AP patients reported presence of periodontal problems among other family members and approximately 41% of them had consanguineous parents, but these were not statistically significant when compared with the CP group. The percentages of mean clinical attachment level (CAL)  $> 3$ mm, mean CAL  $> 5$ mm, and mean pocket probing depth were statistically different between AP and CP groups. We conclude that young age, not smoking, reduced oral hygiene measures, income  $< 625$  Euro/month, urban residency and regular attendance to dental/periodontal clinics are associated with increasing risk of AP. However, it appears that the impact of these environmental risk factors is less in AP than in CP.

**Key words:** aggressive periodontitis, chronic periodontitis, Jordan, risk indicators

## INTRODUCTION

Periodontitis is a group of diseases of the periodontium that is manifested as progressive destruction of the periodontal ligament and alveolar bone, with pocket formation, gingival recession, or both (Kinane, 1999). The various forms of periodontitis have a multi-factorial aetiology; microbial plaque is the initiating factor of these diseases, whereas their manifestations and progression are influenced by a wide variety of other determinants and factors.

Periodontitis was classified by the International Workshop for Classification of Periodontal Diseases in 1999 as aggressive periodontitis (AP), chronic periodontitis (CP), and periodontitis as a manifestation of systemic diseases (Armitage, 1999).

AP is a distinct type of periodontitis that was formerly termed early-onset periodontitis (EOP). It affects people who, in most cases, otherwise appear healthy. It tends to have a familial aggregation and the amount of microbial deposits may be



inconsistent with the severity of periodontal destruction (Armitage, 1999). In AP, there is a rapid rate of disease progression and the disease occurs in localised and generalised forms. Several risk factors and indicators of periodontal diseases, including AP, have been identified. These include: age, gender, ethnicity, microbiological factors, genetic factors, host defence factors, oral hygiene habits, frequency of dental visits, income level, education level, place of residence, smoking habits, social and behavioral factors, and psychological factors (Brown et al, 1994; Papapanou, 1996; Beck et al, 1997; Elter et al, 1999). Confirmed risk factors for periodontitis in adults include microbiological and genetic influences, smoking, diabetes, race, low education and infrequent dental attendance (Pihlstrom, 2001). There is lack of information regarding risk factors and indicators of AP in Jordanian adults. The aim of this study was to investigate the relationship between some risk indicators and AP in a sample of periodontal patients attending the student periodontal clinic in the Jordan University of Science and Technology (JUST) Dental Teaching Centre in Irbid. Factors studied included age, gender, place of residence, income, level of education, occupation, oral hygiene habits and status, frequency of dental visits, smoking duration and frequency (if applicable), family history of periodontal diseases and parents' consanguinity. The reason for selecting these specific risk indicators is the strong associations with AP, as demonstrated by previous studies (Pihlstrom, 2001; Nunn, 2003). In addition, it was our aim to compare the effects of these risk indicators on AP with their effects on CP.

## STUDY DESIGN

### Patients

The present study is a case control study that was conducted on a sample of the Jordanian population attending JUST Dental Teaching Centre in Irbid (North Jordan) between the beginning of October 2003 and the end of March 2004. This teaching centre is part of the faculty of Dentistry, JUST, where undergraduate and postgraduate dental students receive their clinical training. It is also a referral centre in the north of Jordan. The sample consisted of 195 patients attending the periodontal clinic, who denied having any other relevant medical

problems and were older than 15 years of age. The disease group (109 subjects) consisted of 27 males and 82 females diagnosed as having AP (localised or generalised). The controls were 86 subjects (30 males and 56 females) diagnosed as having CP.

### Methods

All patients were examined clinically and radiographically. Patients who had been diagnosed as having AP or CP, according to the 1999 American Academy of Periodontology classification (Armitage, 1999), were included in the study. Patients who were excluded from the study were those who reported having the following medical problems: diabetes mellitus, cardiovascular diseases, blood disorders, asthma, pregnant women, and patients taking long-term medications (such as non-steroidal anti-inflammatory drugs, steroids, contraceptives or immunosuppressive drugs). In addition, patients who had received periodontal treatment, or had taken antibiotics within the last 3 months, as well as patients receiving orthodontic treatment were excluded.

A structured questionnaire was completed for each patient by the examiner. It included: age, gender, place of residence, income, level of education, occupation, oral hygiene habits and status, frequency of dental visits, smoking duration and frequency (if applicable), family history of periodontal diseases and parents' consanguinity. For each patient, a full mouth examination was carried out on a dental chair using a sterile dental mirror and periodontal probe (Michigan O periodontal probe with William's markings, Diatech, Switzerland) and the data were recorded on a special examination form. These data included probing pocket depth (PPD), clinical attachment level (CAL), gingival index (GI) of Löe and Silness (1963), plaque index (PI) of Silness and Löe (1964). The PPD and CAL values were obtained for each patient by examining the whole circumference of each tooth (i.e. facially and lingually, including the buccal and facial interproximal surfaces) and recording the highest facial and lingual readings. For each subject, the clinical diagnosis was confirmed radiographically.

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Table 1 Socio-demographic characteristics of the study population.

| Variables                 |              | Aggressive periodontitis (%) | Chronic periodontitis (%) | P-value <sup>a</sup> |
|---------------------------|--------------|------------------------------|---------------------------|----------------------|
| Age                       | ≤35          | 70 (64.2)                    | 32 (37.2)                 | <0.05 <sup>c</sup>   |
|                           | >35          | 39 (35.8)                    | 54 (62.8)                 |                      |
|                           | Mean age     | 31.86                        | 37.81                     |                      |
| Gender                    | Female       | 82 (75.2)                    | 56 (65.1)                 | 0.154                |
|                           | Male         | 27 (24.8)                    | 30 (34.9)                 |                      |
| Occupation                | Without work | 61 (56)                      | 50 (58.1)                 | 0.253                |
|                           | Working      | 32 (29.3)                    | 30 (34.8)                 |                      |
|                           | Student      | 16 (14.7)                    | 6 (7.1)                   |                      |
| Income/month <sup>b</sup> | <625 Euro    | 98 (89.9)                    | 71 (82.5)                 | 0.198                |
|                           | ≥625 Euro    | 11 (10.1)                    | 15 (17.5)                 |                      |
| Place of residence        | Urban        | 52 (47.7)                    | 30 (34.9)                 | 0.071                |
|                           | Rural        | 57 (52.3)                    | 56 (65.1)                 |                      |
| Education level           | Primary      | 30 (27.5)                    | 26 (30.2)                 | 0.491                |
|                           | Secondary    | 40 (36.7)                    | 36 (41.9)                 |                      |
|                           | College      | 16 (14.7)                    | 13 (15.1)                 |                      |
|                           | University   | 23 (21.1)                    | 11 (12.8)                 |                      |

<sup>a</sup> Chi-square test.

<sup>b</sup> 1 Euro ≈ 0.8 Jordanian Dinar.

<sup>c</sup> Statistically significant at  $\alpha \leq 0.05$ .

#### Statistical analysis

All variables were entered into a personal computer, and the Statistical Package for Social Sciences (SPSS) software was used for data processing and analysis. Frequency distribution and cross-tabulation were produced. Mean values and standard deviation were calculated, and Chi-square, t-test, and univariate analysis of variance were used for comparison. Logistic regression analysis, analysing the association between explanatory and independent variables, was performed. Multivariable logistic regression analysis was performed to test the association of the outcome, the AP, with the independent or explanatory variables that were included in the model.

## RESULTS

### Socio-demographic characteristics

The sample used in this analysis consisted of 109 subjects with AP and 86 subjects with CP. The ages ranged between 15 and 47 years in the AP group with a mean age of 31.86 years, and between 18 and 49 years in the CP group with a mean age of 37.81 years. The socio-demographic characteristics of the study population are presented in Tables 1 and 2.

In this study, 64.2% of AP patients were ≤35 years of age, and 35.8% were >35 years of age. In the CP group, the majority of patients (62.8%) were >35 years, and 37.2% were ≥35 years of age.

**Table 2** Distribution of age and gender among aggressive and chronic periodontitis groups.

| Age (years) | Aggressive periodontitis |           |           | Chronic periodontitis |           |           |
|-------------|--------------------------|-----------|-----------|-----------------------|-----------|-----------|
|             | Females (%)              | Males (%) | Total (%) | Females (%)           | Males (%) | Total (%) |
| 15–25       | 21 (19.3)                | 8 (7.3)   | 29 (26.6) | 6 (7)                 | 1 (1.1)   | 7 (8.1)   |
| 26–35       | 32 (29.4)                | 9 (8.3)   | 41 (37.6) | 19 (22.1)             | 6 (7)     | 25 (29.1) |
| >35         | 29 (26.6)                | 10 (9.2)  | 39 (35.8) | 31 (36)               | 23 (26.8) | 54 (62.8) |
| Total       | 82 (75.2)                | 27 (24.8) | 109 (100) | 56 (65.1)             | 30 (34.9) | 86 (100)  |

This difference between AP and CP groups with respect to age was statistically significant ( $p < 0.05$ ) (Table 1).

The results showed that 75.2% of patients with AP were females and 24.8% of AP patients were males. Of the patients with CP, 65.1% were females and 34.9% were males (Table 1). More detail regarding the age and gender distribution of the study population is presented in Table 2, which shows that the majority of AP patients were females aged between 26 and 35 years. Table 2 also shows that the majority of CP patients were females over 35 years of age. Most of the subjects in both disease groups were not working (56% of patients with AP and 58.1% of CP patients) (Table 1). The percentage of working patients in the AP group was 29.3% and in the CP group was 34.8%. Table 1 shows that 14.7% of AP patients and 7.1% of CP patients were students.

With regard to family income, the results demonstrated that in both disease groups the majority of patients had an income less than 625 Euros (approximately 500 JD) per month (89.9% of patients with AP and 82.5% of patients with CP) (Table 1). As for the place of residence, the majority of AP patients (52.3%) and of CP patients (65.1%) lived in rural areas. With regard to education, the majority of patients in both disease groups had completed secondary education only (36.7% of AP patients and 41.9% of CP patients).

### Oral hygiene habits and frequency of dental visits

The oral hygiene habits and frequency of dental visits of both AP and CP patients are shown in

Table 3. Among the whole study population, only six patients reported not brushing their teeth (five were AP patients and one was a patient with CP). Of AP and CP patients respectively, 95.4% and 98.8% reported brushing their teeth. The highest percentage of patients in both disease groups reported brushing their teeth 1–2 times daily (53.9% of AP and 71.8% of CP patients). The difference between AP and CP groups, with respect to frequency of toothbrushing, was statistically significant ( $p = 0.022$ ). Among AP subjects who reported brushing their teeth, the majority (48.1%) reported brushing their teeth for 1–2 minutes each time. The same was true for the CP group, where 63.5% of subjects reported brushing their teeth for 1–2 minutes. The difference between AP and CP groups with respect to duration of brushing (Table 3), was statistically significant ( $p = 0.006$ ).

Regarding the method of toothbrushing, the majority of AP subjects (54.8%) reported using a vertical method (up and down), while only 5.8% of AP patients reported brushing their teeth using the modified Bass technique. In CP patients, the majority (69.4%) reported brushing their teeth using the vertical method, while none of them reported using the modified Bass technique. As for the type of toothbrush, the majority of patients in both disease groups (47.1% of AP patients and 61.2% of CP patients) reported using soft toothbrushes.

The majority of patients (94.2% of AP patients and 95.3% of CP patients) in this study did not attend dental clinics for regular check-up and treatment; they attended dental clinics only in cases of emergency.



Table 3 Oral hygiene habits and frequency of dental visits.

| Variables                     |                  | Aggressive periodontitis (%) | Chronic periodontitis (%) | P-value <sup>a</sup> |
|-------------------------------|------------------|------------------------------|---------------------------|----------------------|
| Brushing                      | Yes              | 104 (95.4)                   | 85 (98.8)                 | 0.022 <sup>b</sup>   |
|                               | No               | 5 (4.6)                      | 1 (1.2)                   |                      |
| Frequency of brushing per day | 0                | 5 (4.5)                      | 1 (1.2)                   | <0.05 <sup>b</sup>   |
|                               | <1               | 29 (27.9)                    | 18 (21.2)                 |                      |
|                               | 1–2              | 56 (53.9)                    | 61 (71.8)                 |                      |
|                               | ≥3               | 19 (18.3)                    | 6 (7.1)                   |                      |
| Duration of brushing          | <1 min           | 6 (5.8)                      | 3 (3.5)                   | 0.006 <sup>b</sup>   |
|                               | 1–2 min          | 50 (48.1)                    | 54 (63.5)                 |                      |
|                               | 3–5 min          | 36 (34.6)                    | 28 (33)                   |                      |
|                               | >5 min           | 12 (11.5)                    | 0 (0.0)                   |                      |
| Method of brushing            | Horizontal       | 7 (6.7)                      | 4 (4.7)                   | 0.096                |
|                               | Vertical         | 57 (54.8)                    | 59 (69.4)                 |                      |
|                               | Circular         | 10 (9.6)                     | 8 (9.4)                   |                      |
|                               | Scrub            | 24 (23.1)                    | 14 (16.5)                 |                      |
|                               | M-Bass technique | 6 (5.8)                      | 0 (0.0)                   |                      |
| Type of toothbrush            | Soft             | 49 (47.1)                    | 52 (61.2)                 | 0.118                |
|                               | Medium           | 43 (41.3)                    | 28 (32.9)                 |                      |
|                               | Hard             | 12 (11.5)                    | 5 (5.9)                   |                      |
| Frequency of dental visits    | Regular check-up | 11 (10.6)                    | 4 (4.7)                   | 0.185                |
|                               | In an emergency  | 98 (94.2)                    | 82 (95.3)                 |                      |

<sup>a</sup> Chi-square test.

<sup>b</sup> Statistically significant at  $\alpha \leq 0.05$ .

### Smoking habits

Only seven patients with AP reported smoking (6.4%). Among these, six patients (85.7%) reported smoking cigarettes, none of them reported smoking a water pipe and only one (14.3%) reported smoking a pipe. Four of the cigarette smokers (57.1%) have been smoking for >10 years, and four of the

smoking AP patients reported smoking >20 cigarettes/day. As for patients with CP, 26 (30.2%) were smokers. Of these, 61.5% reported smoking cigarettes, 11.5% reported smoking a water pipe and 27% reported smoking a pipe. Of the smokers in the CP group, 42.3% reported smoking >20 cigarettes/day, and 65.4% of the smokers in the CP



Table 4 Smoking habits of the study population.

| Variables                     |            | Aggressive periodontitis (%) | Chronic periodontitis (%) | P-value <sup>a</sup> |
|-------------------------------|------------|------------------------------|---------------------------|----------------------|
| Smoking                       | Yes        | 7 (6.4)                      | 26 (30.2)                 | <0.05 <sup>b</sup>   |
|                               | No         | 102 (93.6)                   | 60 (69.8)                 |                      |
| Smoking type                  | Cigarette  | 6 (85.7)                     | 16 (61.5)                 | <0.05 <sup>b</sup>   |
|                               | Water pipe | 0 (0.00)                     | 3 (11.5)                  |                      |
|                               | Pipe       | 1 (14.3)                     | 7 (27)                    |                      |
| Numbers of cigarettes per day | <10        | 1 (14.3)                     | 5 (19.2)                  |                      |
|                               | 10–20      | 2 (28.6)                     | 10 (38.5)                 |                      |
|                               | >20        | 4 (57.1)                     | 11 (42.3)                 |                      |
| Years of smoking              | <5 years   | 1 (14.3)                     | 4 (15.4)                  | <0.05 <sup>b</sup>   |
|                               | 5–10       | 2 (28.6)                     | 5 (19.2)                  |                      |
|                               | >10 years  | 4 (57.1)                     | 17 (65.4)                 |                      |

<sup>a</sup> Chi-square test.

<sup>b</sup> Statistically significant at  $\alpha \leq 0.05$ .

group have been smoking for >10 years. There was a statistically significant difference between the two disease groups with regard to smoking (as opposed to non-smoking), as well as to the type, number of cigarettes per day and duration of smoking in years ( $p < 0.05$ ; Table 4).

#### Family history and parents' consanguinity

In the AP group, 60.6% reported presence of periodontal problems among other members of their family, whereas only 43% of patients with CP reported presence of periodontal problems among other family members (Table 5). With regard to parents' consanguinity, 41.3% of AP patients had parents who were related, whereas in 58.7% of AP patients, there was no relation between parents (Table 5). On the other hand, the majority of subjects in the CP group (72.1%), had non-consanguineous parents, and only 27.9% had related parents. Although there was a difference between the two disease groups with respect to parents' consanguinity, this difference was not statistically significant (Table 5).

#### Periodontal measurements

The mean and standard deviation values of the outcome variables are presented in Table 6. The overall mean values of the gingival index for AP and CP subjects were  $1.73 \pm 0.50$  and  $1.76 \pm 0.43$  respectively. The mean values of plaque index for aggressive and CP subjects were  $1.71 \pm 0.79$  and  $1.61 \pm 0.67$  respectively. The mean PPD for AP subjects was  $3.50 \pm 0.97$ , whereas for CP subjects it was  $2.95 \pm 0.67$ . The percentage of CAL >3 mm was higher in AP subjects ( $48.2\% \pm 0.28\%$ ) than in CP subjects ( $30.6\% \pm 0.19\%$ ). In addition, there was a large difference between the percentage of CAL in the AP group ( $20.64\% \pm 0.21\%$ ) and the CP group ( $6.65\% \pm 0.09\%$ ).

#### Multivariate analysis

Table 7 shows the multivariate analysis of factors associated with AP versus CP. Age, income, smoking, residency and frequency of dental visits were the only variables that were significantly associated with the odds of having AP. More specifically, young age, not smoking, income <625 Euros,

**Table 5** Family history and parents' consanguinity of the study population.

| Variables              |     | Aggressive periodontitis (%) | Chronic periodontitis (%) | P-value <sup>a</sup> |
|------------------------|-----|------------------------------|---------------------------|----------------------|
| Family history         | Yes | 66 (60.6)                    | 37 (43)                   | 0.014 <sup>b</sup>   |
|                        | No  | 43 (39.4)                    | 49 (57)                   |                      |
| Parents' consanguinity | Yes | 64 (58.7)                    | 62 (72.1)                 | 0.07                 |
|                        | No  | 45 (41.3)                    | 24 (27.9)                 |                      |

<sup>a</sup> Chi-square test.<sup>b</sup> Statistically significant at  $\alpha \leq 0.05$ .**Table 6** Mean and standard deviation values of periodontal measurements.

| Variables          | Aggressive periodontitis (mean $\pm$ SD) | Chronic periodontitis (mean $\pm$ SD) | P-value <sup>a</sup> |
|--------------------|--|---------------------------------------|----------------------|
| Gingival index     | 1.73 $\pm$ 0.50                          | 1.76 $\pm$ 0.43                       | 0.61                 |
| Plaque index       | 1.71 $\pm$ 0.79                          | 1.61 $\pm$ 0.67                       | 0.33                 |
| Mean PPD (mm/site) | 3.50 $\pm$ 0.97                          | 2.95 $\pm$ 0.67                       | 0.03 <sup>b</sup>    |
| % CAL <3 mm        | 48.20 $\pm$ 0.28                         | 30.60 $\pm$ 0.19                      | <0.05 <sup>b</sup>   |
| % CAL <5 mm        | 20.64 $\pm$ 0.21                         | 6.65 $\pm$ 0.09                       | <0.05 <sup>b</sup>   |

<sup>a</sup> *t*-test.<sup>b</sup> Statistically significant at  $\alpha \leq 0.05$ .

urban residency and regular attendance to periodontology clinics were associated with increased odds of having AP. After adjusting for all the important variables, it was found that family history became non-significant.

## DISCUSSION

This is the first study in Jordan to compare risk indicators of AP and CP. As the periodontal clinics in JUST Dental Teaching Centre are referral clinics, lack of subjects with healthy periodontal conditions made it difficult to include a 'healthy' control group.

### Socio-demographic factors

In the present study, most of the patients who had AP and CP were in the low socio-economic cate-

gories (income < 625 Euros/month), did not work, lived in rural areas, and had completed secondary education only. After adjusting for all other variables in the multivariate analysis, it was found that among all socio-demographic variables included in this study, young age, income <625 Euros and urban residency were the only variables associated with increased odds of having AP.

These findings are in agreement with findings of previous studies (Aass et al, 1988; Brown et al, 1994; Papapanou, 1996; Beck et al, 1997; Drury et al, 1999; Elter et al, 1999; Albandar, 2005), which reported a positive correlation between low socio-economic levels and periodontitis. This could be because people with low socio-economic status may not readily gain access to dental care and education and would, consequently, have low oral hygiene levels and untreated





Table 7 Multivariate analysis of factors associated with aggressive periodontitis.

| Variables          |                 | Odds ratio (95% CI) <sup>a</sup> | P-value |
|--------------------|-----------------|----------------------------------|---------|
| Smoking            | Yes             | 1                                | <0.0001 |
|                    | No              | 6.56 (2.31, 18.60)               |         |
| Age                |                 | 0.91 (0.87, 0.95)                | <0.0001 |
| Residency          | Rural           | 1                                | 0.048   |
|                    | Urban           | 1.82 (1.2, 2.89)                 |         |
| Income             | ≥625            | 1                                | 0.013   |
|                    | <625            | 3.98 (1.33, 11.90)               |         |
| Frequency of visit | In an emergency | 1                                | 0.038   |
|                    | Regular         | 5.89 (1.10, 29.50)               |         |
| Consanguinity      | No              | 1                                | 0.520   |
|                    | Yes             | 1.29 (0.59, 2.81)                |         |
| Family history     | No              | 1                                | 0.340   |
|                    | Yes             | 1.44 (0.68, 3.06)                |         |

<sup>a</sup> CI: confidence interval; Odds ratio is the ratio of odds of exposure in the AP group to the odds of exposure in the CP group.

periodontal disease. Accordingly, it is possible that our findings reflect the fact that JUST Dental Teaching Centre is a university teaching centre where many treatment procedures performed by students are free of charge; therefore persons of lower socio-economic status tend to seek treatment in the centre.

With regard to the place of residence, although most patients lived in rural areas, the multivariate analysis showed that urban residency was associated with increased odds of having AP. This finding probably reflects the fact that urban dwellers were those who could attend the periodontology clinic more easily, or might be more interested in receiving periodontal treatment and preserving their dentition. Therefore, they represented the majority of the sample population.

### Age

The results of this study have shown that AP is manifested earlier in life than CP (i.e. before or at 35

years of age), a finding that has been repeatedly confirmed in previous literature (Papapanou, 1998; Albandar, 2005). Our results are in agreement with results of previous studies (Löe and Brown, 1991; Oliver et al, 1998; Lopez et al, 2001).

The present results have shown that the largest proportion of AP patients included in the study fell in the age category of 26–35 years, whereas the majority of CP patients were over 35 years of age. It is unclear whether the distribution of AP patients in the three age groups (15–25 years, 26–35 years and >35 years) is specific to this study sample or reflects the true distribution of AP in the Jordanian population. Studies on other populations have pointed to a difference in the distribution of AP between different age groups. For example, Löe and Brown (1991) found that 15-year-old American children were 2.3 times more likely to have generalised juvenile periodontitis, and 16–17-year-old children were found to be 3.3





times more likely to have localised juvenile periodontitis, when compared with 14-year-old children. In a survey on Chilean students, Lopez et al (2001) found that subjects aged 15–17 years, as well as subjects aged 18–21 years were more likely to have CAL  $\geq 3$  mm than children who were 12–14 years old. Furthermore, Albandar et al (2002a), following a study on Ugandan students, reported that the prevalence of EOP increased with increasing age. The prevalence was highest in subjects who were 20–25 years old (35%), lower among 17–19 years old subjects (29%), and was lowest among 12–16 years old adolescents (27%). This pattern of positive correlation between the prevalence of periodontitis and age was similar for AP and CP. Albandar et al (2002b) showed that the prevalence of onset of AP in the United States is twice as high in adolescents aged 16–17 years as in children aged 13–15 years. As for CP, in a recent study on Brazilian adults aged >30 years, Susin et al (2005) demonstrated that PPD increased in prevalence with increasing age and levelled off at around 50 years of age. From these studies, it appears that the prevalence of AP increases with age from 15 years until approximately 30 years, and that this relation diminishes after the age of 35 years. However, results of cross-sectional studies have to be interpreted with caution. It is possible that this 'increase in prevalence' of AP with age only reflects the cumulative effects of periodontitis that had started earlier in life. It must be emphasised that in AP, factors other than age play important roles in terms of disease onset and progression. Moreover, the exact relationship between age of onset and progression of AP remains unclear, and necessitates further investigation.

### Gender

In the present study, the percentage of females was approximately 71% of the whole study population (around 75% of AP patients, and 65% of CP patients) and the percentage of males was approximately 29% (around 25% of AP patients, and 35% of CP patients). These results may reflect the true gender distribution of AP and CP in Jordan, or may simply be due to the fact that females appear to be more regular attendees to our clinics than males, and are generally believed to take better care of their oral health than males in other societies (Addy et al, 1994). Alternatively, these results may simply reflect the fact that most of the patients included in

the study were housewives who were able to attend JUST dental teaching centre during its working hours. However, it is not possible to draw any conclusions regarding the prevalence of AP on the basis of the present study, and true prevalence studies in Jordan are needed.

The present findings are in agreement with the Oral Health Survey of the United States (US Public Health Service, National Institute of Dental Research, 1987) and with the results of other studies (Benjamin and Baer, 1967; Horman and Frandsen, 1979; Abdellatif and Burt, 1987), who found a higher prevalence of AP in females. However, our findings are not in agreement with the findings of Albandar et al (1997; 2002a,b), who found a higher prevalence of AP in males. This discrepancy is probably due to dissimilarities between the populations examined. Epidemiological surveys in the USA have shown that periodontal diseases are more prevalent in males than in females (US Public Health Service, National Center for Health Statistics, 1979; US Public Health Service, National Institute of Dental Research, 1987; Marcus et al, 1996; Albandar, 2002b). With regard to AP specifically, reports of the male-to-female distribution of the disease again differed according to the different populations studied. For example, early studies carried out in the USA (Benjamin and Baer, 1967; Horman and Frandsen, 1979) have demonstrated a higher prevalence of EOP in females than in males, whereas later studies in the US have demonstrated a higher prevalence of EOP in males (Albandar et al, 1997). On the other hand, a study carried out in Switzerland (Kronauer et al, 1986) has demonstrated an equal male-to-female distribution of juvenile periodontitis in 16-year-old adolescents of different ethnic groups in Switzerland. Furthermore, it has been suggested (Horman and Frandsen, 1979) that the sex distribution of EOP could be age-dependent, as a higher prevalence of EOP (AP) was observed in females in the youngest age group studied. The authors suggested that this might be attributed to the earlier eruption of first molars and incisors in females. By contrast, Albandar et al (1997), following a national survey in the US involving 13–19-year-old subjects, reported that periodontitis was slightly more prevalent in males than in females, with a male-to-female ratio of 1.3:1. In agreement with this, a survey carried out by Albandar et al (2002a) among Ugandan stu-



dents aged 12–25 years found that periodontitis was more prevalent in males, and the reported male-to-female ratio was 1.5:1. In a survey involving 17–26-year-old American recruits, Melvin et al (1991) found that the overall prevalence of juvenile periodontitis was similar in males and females. However, they observed a significantly higher prevalence of juvenile periodontitis in males than in females when only black recruits were studied, with a male-to-female ratio of 2:1 (Melvin et al, 1991). Löe and Brown (1991) conducted a study on American children of different ethnic backgrounds, aged 14–17 years, and found that males had a higher risk of periodontitis than females irrespective of the type of periodontitis. However, when the distribution of the disease according to gender was examined among ethnic groups, differences became more evident. It was found that black males were 2.9 times more likely to have localised juvenile periodontitis when compared with black females, whereas white females were 2.5 times more likely to have localised juvenile periodontitis than white males (Löe and Brown, 1991). Our results are in agreement with this and it is possible that Jordanians, who are white Caucasians, have a comparable gender distribution of AP. However, further studies on the prevalence of AP in the Jordanian population should be conducted to clarify this aspect. As for CP, Susin et al (2005) reported that in a Brazilian population, the prevalence of increasing PPD was higher in males than in females.

In the present study it was found that after adjusting for all other possible variables, there was no statistically significant association between gender and having AP in comparison with CP. It appears that the effect of gender as a risk factor for AP is closely related to ethnicity and (although less clearly) to age. Further research is necessary to shed light on the relationships of gender, age and ethnicity as interrelated risk factors of AP.

### Oral hygiene habits and frequency of dental visits

In the present study a higher proportion of AP patients reported brushing their teeth regularly, when compared with CP patients. This may be due to the fact that most of the patients were young individuals who are probably more aware of their oral health and appearance. In addition, some AP patients had probably sought dental/periodontal

treatment before, and had received some dental health education. Although more than 95% of the study population reported brushing their teeth, the results of plaque and gingival indices were high. This indicates either that the toothbrushing methods used by patients were incorrect, or that their reports of brushing frequency and duration were inaccurate. After adjusting for all other possible variables, it was found that oral hygiene habits were not statistically associated with AP, which is in agreement with findings of Albandar et al (1996).

The level of oral hygiene in a population is positively correlated with the amount of plaque build-up and thus to the prevalence and severity of periodontal disease (Löe et al, 1965; Abdellatif et al, 1987). However, this might not be true in the case of AP, where it is generally accepted that the amount of dental deposits is inconsistent with the severity of disease, and risk factors other than the level of oral hygiene play important roles in AP onset and progression (Armitage, 1999).

The mean values of plaque index and gingival index (which are believed to reflect an individual's oral hygiene level) in the present study were high, but were not statistically different when the AP and CP groups were compared. However, the mean values of PPD and CAL were higher in AP patients than CP patients and this difference was statistically significant. This indicates that, although the oral hygiene levels were comparable in the two disease groups, AP patients experienced more severe periodontal disease. This implies that AP patients are more susceptible than CP patients to periodontal destruction when challenged with similar amounts of microbial deposits.

Regarding frequency of dental visits, the majority of subjects in this study reported attending dental clinics only in an emergency. However, it was found that after adjusting for other variables, regular attendance to the periodontology clinic was associated with increased odds of having AP. The logical explanation of this seems to be that patients who seek periodontal treatment more often are those who have severe periodontal problems at a relatively younger age, i.e. patients with AP.

These data indicate that the levels of oral health awareness and oral hygiene in the studied population are low. This emphasises the need for constructing proper nationwide oral health promotion and preventive programmes.



### Smoking

The effects of smoking on the periodontal tissues have been extensively studied. Many studies have established a strong association between smoking and impaired periodontal health (Goultechin et al, 1990; Haber and Kent, 1992; Bergström, 2004; Preshaw et al, 2004; Susin et al, 2005). Among many other effects, smoking suppresses oxygen saturation of haemoglobin in the gingiva, modifies the humoral and cellular immune systems and elevates the levels of interleukin-6 (IL-6) and IL-8 in the gingival crevicular fluid (Boström et al, 1999). In the present study, the percentage of smoking AP patients was not high (6.4%) when compared with CP patients (30.2%). This may be due to the fact that the majority of subjects in this study and in the AP group were young females who, in the Jordanian society, usually deny smoking due to social reasons. Among smokers there was a statistically significant difference between AP and CP patients with regard to cigarette smoking, quantity and duration of smoking. However, the multivariate analysis demonstrated that after adjusting for all other variables, not smoking was associated with increased odds of having AP. Our results indicate that AP is associated with subjects who are not heavily exposed to smoking nor have poor oral hygiene, when compared with CP; a fact that again supports the higher susceptibility of AP patients to periodontal breakdown.

### Family history and parents' consanguinity

The aggregation of AP in families has introduced the hypothesis of its genetic inheritance (Loe and Brown, 1991; Marazita et al, 1994). As the immune system is believed to play a crucial role in the pathogenesis of periodontitis, research has been focused on the identification of genetic polymorphisms in several aspects of the host immunity, such as ILs. The first study to report polymorphisms for the IL-1 genes in relation to periodontitis was presented by Kornman et al (1997). Since then a number of gene polymorphisms have been associated with AP. These include gene polymorphisms in IL-1 $\beta$  (Li et al, 2004), IL-6, IL-8, IL-receptor antagonist (Giannopoulou et al, 2003), tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ) (Craandijk et al, 2002), Fc $\gamma$  receptor (van der Pol and van der Winkel, 1998), human leukocyte antigen (HLA) (Amer et al, 1988), vitamin D receptor (Henning et al, 1999), and N-formyl-methyl-leucyl-phenylalanine (fMLP) receptor (Gwinn et al, 1999). In the present study, approximately

60% of AP patients reported a positive family history of periodontal diseases, and although the difference between AP and CP patients in this respect was statistically significant, multivariate analysis demonstrated that family history was not significantly associated with AP.

Marriage between relatives, particularly cousins, is a social habit in the Jordanian society, but was not found to be a risk indicator of AP in the current study. This may be due to the nature and small sample size of the study population. More controlled studies are required to investigate this aspect, and genetic studies should be conducted on affected families.

### CONCLUSIONS

This study has demonstrated that AP is manifested early in life in individuals who are susceptible to the disease. We conclude that risk indicators of AP in this study population in North Jordan include young age and a low income level. In addition, not smoking, urban residency and frequent dental visits were significantly associated with the odds of having AP. Family history and parents' consanguinity were not significant. Our results indicate that AP is associated with subjects who are not heavily exposed to smoking nor have poor oral hygiene, when compared with CP; a fact that supports the higher susceptibility of AP patients to periodontal breakdown.

Nationwide studies are needed to determine the prevalence of AP, CP and other periodontal diseases in Jordan. Further studies to cover different age groups and a larger population are needed to identify risk indicators of AP in Jordan. In addition, further longitudinal and intervention studies are needed to determine whether the identified risk indicators are true risk factors for AP in the Jordanian population. Special studies should be conducted at the genetic level in individuals and families affected by AP. Finally this study has demonstrated the great need for constructing nationwide oral health promotion programmes, in order to improve the level of oral health awareness and standards in the Jordanian population.



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