

# Epidemiology of Periodontal Diseases

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## Lecture Objectives

1. To know the definitions of prevalence and incidence in periodontitis.
2. To describe the prevalence and incidence of periodontal diseases in children and adults.
3. To explain the differences between the old and current concept of age and periodontitis.
4. To identify and describe known risk factors associated with the development of periodontal diseases.
5. To introduce risk prediction models in epidemiology.

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
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## Epidemiology

- Is the study of the distribution and determinants of disease in human populations.
- Simply, is the study of the occurrence of illness in a population and the factors that influence its occurrence.

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## Uses of Epidemiology

1. To determine the cause of a disease (including risk factors).
2. To determine the extent of disease in a community.
3. To study the natural history and prognosis of disease.
4. To develop new preventive and therapeutic measures.

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## Measures of Occurrence of Disease

- Rates (incidence):
  - To express how fast the disease is occurring in the population.
- Proportions (prevalence):
  - To express what fraction of the population is affected.

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## Incidence

- Is the rate of occurrence of **new** disease in a population during a given interval of **time**.

$$= \frac{\text{\# new cases developing in the population at risk during a specified time period}}{\text{\# persons at risk of developing the disease during that period of time}}$$

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## Prevalence

- Is the **number** of persons affected by a disease at specified **point** in time.

$$= \frac{\text{\# cases of a disease in the population at specified point in time}}{\text{\# persons in the population at that specified time}}$$

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## Periodontal Diseases

- *Periodontal disease* is a **generic term** that describes a group of inflammatory conditions affecting tooth-supporting tissues.
- They are grouped into two major categories: *gingivitis* and *periodontitis*.

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## Epidemiology of Gingivitis

- Gingivitis is more prevalent and severe in adolescents and in males compared to females.
- Gingivitis may be associated with hormonal factors (puberty, menstruation, and pregnancy) and/or systemic conditions (diabetes and leukemia).
- Gingivitis precedes periodontitis, but only few gingivitis sites progress to periodontitis.
- Plaque is the primary causative factor in the development of gingivitis.

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## Prevalence of Gingivitis

- US Prevalence:
  - 40% to 60% of schoolchildren;
  - > **82% of adolescents**; and,
  - > 50% of adult population.
- Saudi Prevalence:
  - 100% gingivitis in 5-12 year old children
  - Of these, 14% moderate to severe

Al-Banyan et al. Int J Paediatr Dent. 2000

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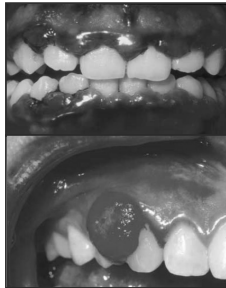
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## Pregnancy Gingivitis

- Is prevalent in 30-100% all pregnant women.
- Begins during the 2<sup>nd</sup> month of pregnancy and increases in severity through 8<sup>th</sup> month and then decreases abruptly.
- Pregnancy hormones:
  - promote the growth of periodontal bacteria
  - Increase vascular proliferation
  - May affect host immune response.



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## Periodontitis in Children and Adolescents

- There are 4 types of periodontal diseases in children:
  - Aggressive periodontitis (US 0.4% - 0.8%)
  - Chronic periodontitis (US 2.3% - 3.2%)
  - Necrotizing periodontal diseases
  - Periodontitis as a manifestation of systemic diseases
- In Saudi children (13-19 ys old): 18% had chronic periodontitis ( $\geq 4$  mm PD) (Guile et al. 1992)
- Studies found that periodontal diseases during childhood or adolescence relate to the presence and severity of periodontal diseases at older ages in the same individuals.

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## Periodontitis in Adults

- The majority of any adult population have mild-moderate levels of periodontitis.
- Severe forms of periodontitis affect only **5%-15%** of any population.
- Epidemiology data show a less clear relationship between dental plaque and severe periodontitis.
- Additional risk factors beyond dental plaque and gingivitis are important in the pathogenesis of severe forms of periodontitis.

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## Periodontitis in Saudi Arabia

- 1987: 240 adults 35-44 years old:
  - 36% periodontitis ( $\geq 4$ mm PD)

Guile et al. 1992
- 2006: 282 adults  $\geq 18$  years old
  - 68% periodontitis ( $\geq 20\%$  bone loss)
  - Of these, 28% had localized and 40% had generalized periodontitis.

Al-Zahrani et al. Oral Health Prev Dent, 2006

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## Incidence of Periodontitis

- Definition of incidence in periodontitis
- Piedmont study, NC: using 3 mm as the incident CAL, 12% of all 65 to 80 y developed new incident CAL after 3 years.
- Sri Lanka study: where the group studied received virtually no dental treatment, about 8% of 14 to 46 y tea workers demonstrated rapid progression of periodontitis, 81% showed moderate progression, and 11% showed no disease progression, after 15 years of follow up.

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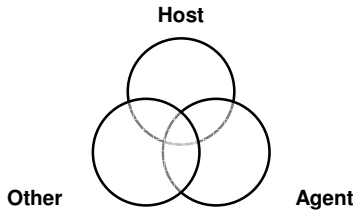
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## Etiology of Periodontal Diseases



Periodontitis is an outcome of a complex interplay between bacterial infection and host response, often modified by other factors.

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## Host Response

- The inflammatory reaction in periodontitis is initiated by a microbial insult of different periodontal microflora.
- A competent host response would normally offset the insult.
- A deficient response may result in severe attachment loss e.g., HIV-infected patients.
- A hyper-active immune response may lead to excessive production of cytokines and other inflammatory mediators leading to excessive destruction.
- Systemic diseases, genetics, physiologic and psychosocial factors may modify host response.

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## Microbial Agents: Bacteria

- Quantity vs. quality of plaque
  - Oral cavity > 500 different bacterial types.
  - Gm-ve anaerobes and facultative microorganisms.
- *A. actinomycetemcomitans*, *P. gingivalis*, *B. forsythus* (now *T. forsythensis*), *P. intermedia*, *T. denticola*, *Coprocyclophaga* species, *Eikenella corrodens*, and *Camphylobacter rectus* are found in subgingival plaque in periodontitis patients.
- Three specific pathogens (*A.a.*, *P.g.*, *B.f.*) have been identified as etiologic agents in the periodontal destruction associated with chronic periodontitis.
- Supragingival plaque serves as a natural reservoir for these microflora.

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## Dental Plaque and Periodontal Diseases

- Dental plaque is a primary etiologic factor in the development of **gingivitis** and **chronic periodontitis**.
- Dental plaque and gingivitis are strongly linked, irrespective of age, gender, and racial/ethnic identifications.
- A less pronounced relationship exists between dental plaque and **severe** periodontitis.
- Risk factors beyond gingivitis and dental plaque are important in the onset and pathogenesis of severe periodontitis.

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## Risk Factors/Indicators for Periodontitis

1. **Demographic**
2. **Systemic diseases**
3. **Tobacco use**
4. **Genetics**
5. **Psychological**
6. **Obesity & Nutrition**
7. **Oral hygiene**
8. **Other**

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## 1. Demographic Risk Factors

- Age
- Gender
- Race/ethnicity
- SES

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## Age and Children

- The prevalence of early onset aggressive periodontitis is 2X higher in adolescents aged 16-17 years than children 13-15 years.
- Age is a significant risk factor for aggressive periodontitis in children.
- Other studies also found a similar positive correlation between chronic gingivitis in children and age.

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## Age and Adults: Cross-Sectional Studies

- Prevalence of periodontitis increases with age. In 1985-86 NIDR survey:
  - CAL  $\geq$  2 mm : 70% in 34-44 y; 90% in 55-64 y.
  - CAL  $\geq$  4 mm : 14% in 25-34 y; 54% in 55-64 y
  - PD 4-6 mm: 13% in adults; higher in older adults
- This relationship is contingent on the severity of periodontitis.
  - Mild periodontitis increased in prevalence by age.
  - Mod-severe periodontitis increased in prevalence to approx. age 65, remained steady until 80, and decreased thereafter.

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## Age and Adults: Longitudinal Studies

- Norwegian study: Norwegian professionals and students, whom OH was excellent, showed no increase in incidence or severity of gingivitis between teen years and age 40.
- Other longitudinal studies such as the Piedmont and the Sri Lanka studies support this finding.
  - The greater periodontal destruction seen in the elderly reflects lifetime disease accumulation, **NOT** an age-specific condition.

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## Gender

- Males have higher prevalence and severity of periodontal diseases than females across all age groups.
- The Plaque Index and Calculus Index scores are higher in males compared to females in the NHANES I survey:
  - PI: males =0.75; females=0.57
  - CI: males =0.41; females =0.30
- OH, physiological, and behavioral factors may be contributing to this difference.

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## Race/Ethnicity

- Prevalence and severity of periodontitis
  - US: Blacks > Mexican > Whites
  - US: Native Americans; Asians; and Pacific Islanders have more severe disease.
  - UK: Asian > Whites
- Plaque and Calculus Index scores:
  - PI: Blacks =0.94; Whites =0.62
  - CI: Blacks =0.62; Whites =0.32
- Blacks less regular users of dental care than Whites.
- Biological factors may increase Blacks' risk for disease
- SES may be confounding these factors

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## Socioeconomic Status (SES)

- Gingivitis and poor OH are clearly related to lower SES, but the relationship between periodontitis and SES is less direct.
- Prevalence of CAL at all levels of severity was not related to household income.
- However, the CAL of  $\geq 4$  mm and  $\geq 7$  mm were both related to level of education.
- Better OH, more positive attitudes toward OH, higher frequency of dental visits, are more prevalent among the highly educated.

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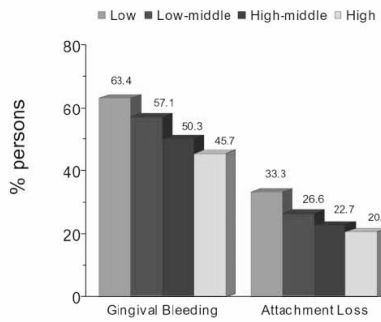


Fig. 18. Percentage of persons with gingival bleeding or with  $\geq 4$  mm attachment loss, by socioeconomic status, United States 1988-1994 (77).

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## 2. Systemic Disease and Periodontitis

- Papillon-Lefèvre syndrome, Chédiak-Higashi syndrome, Down's syndrome, and diabetes are among many conditions that present with severe periodontal disease.
- Most of these conditions show manifestations of PMNs dysfunction.
  - Absolute PMNs count
  - Rolling along vascular endothelium
  - Adherence to the endothelial lining
  - Migration (chemotaxis) toward the site of infection
  - Adherence to microorganisms
  - Engulfment of bacteria (phagocytosis)
  - Intracellular killing
- These defects may be inherited, acquired, or drug-induced.

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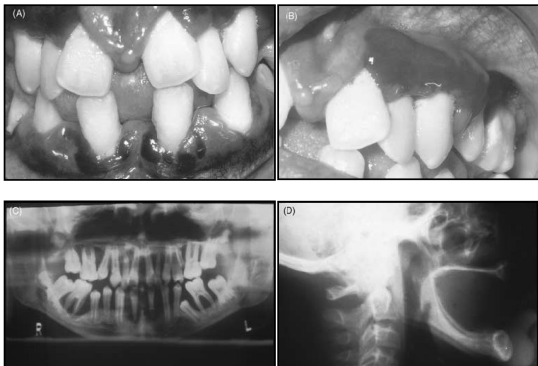
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## Diabetes Mellitus

- Diabetes is *causally* associated w/ periodontitis.
- Diabetics (I & II) have higher prevalence and severity of periodontitis than Non-diabetics.
- Controlled diabetics are 2x as likely to develop periodontal bone loss compared to non-diabetics; and, poorly controlled diabetics are 5x as likely to develop bone loss compared to controlled diabetics.
- Diabetics have poorer response to periodontal Therapy.

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## Periodontitis in Diabetics

- Diabetes promotes periodontal tissue loss by:
  - Forming advanced glycation end products (AGP).
  - Stimulating an exaggerated inflammatory response.
  - Reducing the ability of fibroblasts to form collagen and reduce their response to growth factors.
- A recent critical review suggested there is not enough evidence to suggest that periodontal therapy may have a clinical impact on metabolic control of diabetes

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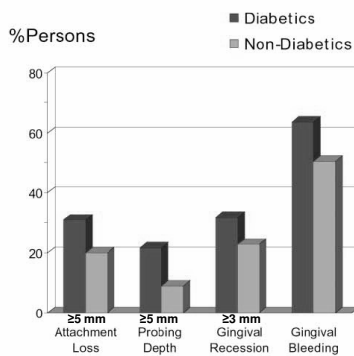


Fig. 4. Percentage of persons 30 years and older with various periodontal parameters, by diabetes status. Adjusted for age, gender, and race-ethnicity. NHANES III, United States 1988–1994 (204).

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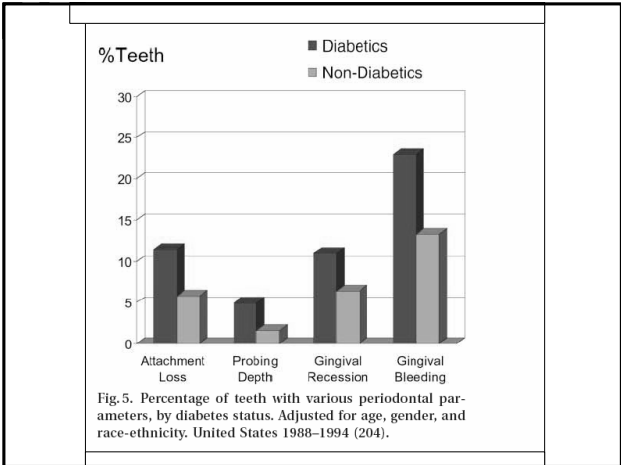
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### HIV Infection

- HIV patients may present with common forms of periodontal disease such as chronic periodontitis.
- They present with higher prevalence of bone loss and CAL accompanied by greater degree of *gingival recession* and *shallow probing depths* compared to control populations which is attributed to deficiencies in host immune response.
- The effect of HIV infection on long-term prognosis of the dentition is unresolved.

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### Osteopenia & Osteoporosis

- Most observational studies support the possible role of low skeletal bone mineral density (BMD) as a risk indicator for periodontitis.
- Women with osteoporosis and poor OH are at higher risk for CAL than women w/o osteoporosis, and osteoporotic women w/ good OH.
- In osteoporotic women, estrogen supplementation prevents loss of skeletal and alveolar BMD, and tooth loss.

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### 3. Tobacco

- Cigarette smoking is **causally** associated with periodontitis. A stronger risk factor than insulin-dependent diabetes.
  - Strength of association
  - Dose-effect relationship
  - Temporal relationship
- Multiple mechanisms of action
  - Smoking suppresses gingival microcirculation
  - Smoking impairs the immune system
  - Inhibition of growth and attachment of fibroblasts in the periodontal ligament of smokers
- Smokeless tobacco have limited and more localized effect on the periodontal tissue (mainly gingival recession).

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### 4. Genetics

- The role of genetics in the development of chronic periodontitis is not clear.
- A genotype of IL-1 gene cluster is associated with severe periodontitis (1<sup>st</sup> report in 1997)
- A combination of IL-1 genotype and smoking history may provide a good risk profile for patients.
- At present, inducing periodontal patients to stop smoking would be a higher priority than genetic testing.

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### 5. Psychological Factors

- High stress & low coping strategies are associated with periodontitis.
- Advanced periodontal disease usually prevalent in individuals diagnosed with major depression.
- Stress and depression may contribute to less favorable response to periodontal therapy.
- Stress can down-regulate the cellular immune response promoting periodontal breakdown.
- Patients with high stress/low coping and those with clinical depression may also have less oral health motivation.

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## 6. Obesity & Nutrition

- Obesity is associated with a higher periodontitis prevalence.

Al-Zahrani et al., J Periodontol 2003;  
Alabdulkarim et al., J Int Acad Periodontol 2005

- Poor diet quality is associated with higher periodontitis prevalence.

Al-Zahrani et al., J Periodontol 2003;  
Al-Zahrani et al., J Int Acad Periodontol 2005

- Increased physical activity is associated with lower risk and prevalence of periodontitis.

Merchant et al., Eur J of Epidem 2003  
Al-Zahrani et al., J Periodontol 2005;  
Al-Zahrani et al., J Dent 2005;

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## 7. Oral Hygiene

- On a population level, level of oral hygiene is positively associated with the prevalence of periodontal diseases, regardless of age.
- On an individual level, measures of *plaque and/or calculus only* poorly predict future periodontitis.
- Intensive OH programs may not be as effective in preventing aggressive forms of periodontal diseases.

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## 8. Other Local Factors

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|----------------------------------|--|
| ■ Tooth morphology and alignment | ■ Contact between teeth                      |
| ■ Form & location of furcation   | ■ Trauma from occlusion                      |
| ■ Alveolar bone morphology       | ■ Dental caries lesions near gingival tissue |
| ■ Gingival form                  | ■ Level and quality of restorations          |

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## **Periodontitis: A Risk Factor for Other Diseases**

- Cardiovascular diseases and coronary artery disease.
- Pre-term and LBW.

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## **Risk Assessment of Periodontitis**

- Predicting future risk of periodontitis requires designing and conducting longitudinal studies.
- Multiple risk factors, that are easily measured, better predict future risk of disease than any one single predictor.
- Prediction models help clinicians in assessing patients' risk of future disease, and in selecting individual treatment protocols for these patients.

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**Thanks for Listening!**

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