Tooth Loss in a Young Population from South Brazil

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Abstract

Objectives: *To assess the prevalence, extent, and risk indicators of tooth loss in a representative young urban population from south Brazil.* ***Methods:*** *A representative sample was drawn using a multi-stage probability cluster sampling strategy, and consisted of 612 subjects 14-29 years of age in the metropolitan area of Porto Alegre, Brazil. A clinical examination was carried out by 4 calibrated examiners in a mobile examination center.* ***Results:*** *The prevalence of tooth loss was 44.8%, 26%, and 60%, and the mean tooth loss was 1.4, 0.6, and 2.4 teeth in the age groups 14-29, 14-19 and 25-29 years, respectively. First molars were the most frequently missing teeth, and the mandibular incisors and canines were the least missing teeth. Tooth loss increased sharply with age, and was similar in males and females. Having ≥4 missing teeth was significantly associated with low socioeconomic status and heavy smoking, and was significantly more likely in persons who had ≥2 teeth with caries/fillings and/or ≥5 mm attachment loss.* ***Conclusion:*** *Tooth loss is a dental health concern in this young Brazilian population. Community-based oral diseases prevention programs targeting groups having these risk factors should be implemented to reduce tooth loss.*

Key Words: epidemiology; tooth loss; risk indicators; cigarette smoking, socioeconomic status, periodontal disease, dental caries

Introduction

During the past few decades the extent of tooth loss has declined considerably in many countries, particularly among younger age groups (1-5). Effective oral health promotion and increased public interest in good oral health (6, 7) are two of the main reasons for this improvement. Population prevention strategies may have contributed to a shift in the distribution of oral diseases. In this context, the identification of these high-risk groups becomes a priority for prevention programs aiming at reducing health disparities.

Tooth retention is a complex phenomenon. Dental caries is the main reason for tooth loss in young persons (8-11). Nevertheless, cultural beliefs, socioeconomic characteristics, and other demographic and behavioral variables have a great impact on the tooth retention profile of any population (10-13). Limited access to dental care (9-11) and the dental practitioner's philosophy of treatment may also influence the decision to extract teeth (1, 14).

Information in developing countries about the frequency of tooth loss and its risk factors is scarce. A systematic search of English (PubMed) and Spanish/Portuguese literature (LILACS) found few published reports for Latin American countries (15, 16). A study conducted in 1986 surveyed major metropolitan areas in Brazil and estimated that the mean tooth loss in the age group 15-19 years was 1.2 teeth (15). Preliminary findings from a large national survey conducted recently in Brazil indicate a slight decrease in mean tooth loss (16). The aim of the present study was to assess the prevalence, extent, and risk indicators of tooth loss in a representative young urban population from south Brazil.

Materials and Methods

Study design. This cross-sectional survey examined a group of young individuals 14-29 years old who were a subset derived from a larger sample representative of the population of Porto Alegre in the Brazilian state of Rio Grande do Sul (17). This state is located in the southern part of Brazil, neighboring Argentina and Uruguay. The present survey covered 14 major municipalities from the Porto Alegre metropolitan area, with a total population of approximately 3 million subjects.

A representative sample of the target population was derived based on a multistage probability sampling method using information provided by Rio Grande do Sul State Government Agency for Metropolitan Affairs (METROPLAN) and the Brazilian Institute of Geography and Statistics (IBGE). Primary sampling units (PSU) were selected randomly from geographic areas that had been stratified by income level. The PSUs were selected with a probability proportional to size and using a sampling frame of these PSUs. Area sectors were then selected randomly within each geographic area, and the number of sectors selected was proportional to the number of sectors in each area. Households were sampled consecutively within the selected sectors.

Exclusion criteria for the study were presence of physical or mental

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diseases and conditions that might pose health risks to the participant or examiner, or that might interfere with the clinical examination. Individuals requiring a prophylactic regimen of antibiotics were provided with the appropriate medicine before the clinical examination.

Study sample. The study sample included 612 individuals aged 14 – 29 years, and comprised 291 (47.5%) males and 321 (52.5%) females, 507 (82.8%) whites and 105 (17.2%) non-whites.

Interviews and clinical examinations. Letters explaining the aims of the study, with an invitation to participate in the study, were sent in advance to households that had been selected. Later, the primary investigator visited the households and explained the aims of the study and encouraged participation. Eligible, consenting subjects were interviewed to gather demographic, socioeconomic, oral health and other health-related data using a structured written questionnaire.

The clinical examinations were performed in a mobile examination center consisting of a trailer equipped with a complete dental unit. Four dentists conducted the clinical examinations, and two trained dental assistants recorded the data on prepared record sheets. A full-mouth clinical examination, excluding third molars, was performed. The examination included an assessment of the status of the permanent teeth and periodontal tissue.

A tooth with an unmistakable cavity, undermined enamel, a detectably softened floor or wall, or a temporary filling was scored as decayed. Filled teeth were defined as those having a permanent restoration (18). The number of decayed and/or filled teeth was calculated for each subject. Clinical attachment loss was defined as the distance from the cementoenamel junction (CEJ) to the bottom of the pocket/sulcus, and was calculated as the sum of the probing depth and gingival recession measurements. A manual periodontal probe (PCP10-SE, Hu-Friedy Mfg. Co. Inc., Chicago, USA) color coded at 1,2,3,5,7,8,9,10 mm was used. Six sites per tooth were assessed at the mesiobuccal, mid-buccal, distobuccal, distolingual, mid-lingual, and mesiolingual sites. Measurements were made in millimeters and were rounded to the lower whole millimeter.

Ethical considerations. The study protocol was reviewed and approved by the following committees: Research Ethics Committee, Federal University of Rio Grande do Sul, Porto Alegre, Brazil; the National Commission on Ethics in Research, Ministry of Health, Brasilia, Brazil; Ethics in Medical Research Committee, University of Bergen, Bergen, Norway.

Subjects who agreed to participate signed a written informed consent form prior to inclusion in the study. The participants were provided with a written report detailing their oral status and a recommendation about suggested treatment alternatives. Patients diagnosed with oral mucosal lesions were informed about the finding and advised to seek specialist consultation and treatment.

Data analysis. Prevalence of tooth loss was defined as the percentage of individuals with one or more missing teeth, and extent was defined as the number of missing teeth per person.

Race was scored as "white" or "non-white." The non-white group was comprised of blacks and mulattos because there are no reliable criteria to distinguish between these two groups. Socioeconomic status was scored by combining information about family economy using a standard Brazilian economy classification (19) and the level of education of the individual. High socioeconomic status was defined as having ≥9 years of education and being in the upper two tertiles of the CCEB economy classification, or having 5-8 years of education and being in the highest third of the Brazilian economy classification. Low socioeconomic status was defined as having 1-4 years of education, and being in the lowest two thirds of the economy classification, or having 5-8 years of education and being in the lowest third of the economy classification. Individuals who had higher economic status and education than the low socioeconomic group, but lower economic status than the high group were classified as having a middle socioeconomic status. Most participants in this study claimed using a toothbrush regularly at least once a day. This variable was therefore not used in the present analysis.

The total exposure to cigarette smoking was calculated for current and former smokers combined. The total number of packs of cigarettes consumed in a lifetime was calculated as the number of cigarettes consumed per day, multiplied by number of years of habit, divided by 20 cigarettes/pack. Individuals were classified into 4 groups: non-smokers (<1 pack of cigarettes in a lifetime), light (1 – 499 packs), moderate (500 – 1499 packs) and heavy smokers (≥1500 packs).

The relationship between two thresholds of tooth loss (≥1 and ≥4 teeth) and the occurrence of attachment loss ≥3 mm and ≥5 mm, and the presence of decayed/filled teeth, was assessed. Subjects were classified by periodontal status as either having ≥2 teeth or ≥1 tooth with attachment loss ≥3 mm or ≥5 mm, and by dental status as either having ≥2 teeth or ≥1 tooth with dental caries and/or restorations.

Data analysis was performed using computer software (Stata 7.0 for Windows, Stata Corporation, College Station, TX, USA) and using survey commands that take into account the survey design, including stratification, clustering, and weighting and robust variance estimation. Clusters were geographic areas defined in maps and were stratified into low or high-income according to IBGE criteria. A weight variable was used to adjust for the probability of selection and deviations in the sample distributions from the target population distribution by age, gender and education (20, 21).

Pairwise comparisons of crude estimates were carried out using the Wald test (21). The chosen level of statistical significance was $p \leq 0.05$. Binary logistic regressions were

performed to model the relationship between tooth loss and various predictors. The dependent variable was defined as the presence of ≥1 and ≥4 missing teeth. The probability of occurrence of tooth loss was expressed as odds ratio (OR). Two models were fitted, one including demographic, socioeconomic and behavioral variables, and the other including tooth and periodontal status. In each analysis, a model was first fitted in which all potential risk indicators were entered, and those that did not contribute significantly to the model were then excluded. Confounding and interactions were evaluated.

Measurement reproducibility. The examiners were calibrated at two time points: before, and 3 months following the start of the study. In addition, the examiners' reproducibility in assessing tooth loss, DMFT and attachment loss was assessed during the fieldwork. One examiner with the most clinical experience served as the "gold standard" examiner. A total of 57 subjects, divided into four groups ranging from 8 to 20 subjects, were used for the reproducibility assessment. In one of the groups, the replicate measurements consisted of repeated measurements by the reference examiner. In each of the remaining 3 groups, the replicate measurements were made by one examiner and the reference examiner. The reproducibility of measurements was assessed by the intraclass correlation coefficient (22), and the kappa statistics. The intraclass correlation coefficients for the number of missing teeth per subject ranged between 0.99 and 1.0, and the kappa coefficients for the types of missing teeth ranged between 0.98 and 1.0. The kappa coefficients for DMFT ranged from 0.89 to 0.98. The intraclass correlation coefficients for the percentage of teeth with attachment loss ≥5 mm ranged between 0.82 and 0.97.

Ninety-seven (97) subjects of the study sample were interviewed a second time by the gold standard examiner 1-4 days following the first interview. The kappa coefficients for the self-reported smoking and socioeconomic status were 0.92 and 0.93, respectively.

Results

Overall, 44.8% of the subjects had lost ≥1 teeth, and 13.6% had lost ≥4 teeth. The mean tooth loss for the whole sample was 1.4 teeth. The prevalence of tooth loss increased markedly with age, from 26% to 60% in the age groups 14-19 and 25-29 years, respectively (Table 1). None of the subjects were completely edentulous. Analysis by tooth type showed that the first molars were the teeth most frequently missing, with 31% and 15% of the persons having lost at least one mandibular and maxillary first molar, respectively (Fig. 1). The mandibular incisors and canines were the least frequently missing teeth.

The prevalence and extent of tooth loss were not significantly different between males and females. Whites had somewhat higher number of missing teeth than non-whites, although the difference was not statistically significant (Table 1). There was a significant negative correlation between socioeconomic status and tooth loss, with individuals in the high socioeconomic group having lower prevalence and mean tooth loss than those in the low socioeconomic group. Also, smoking behavior was significantly associated with tooth loss, with a higher occurrence of tooth loss among heavy smokers compared to non-smokers. The occurrence of ≥4 missing teeth was significantly more frequent in the low than in the high socioeconomic status groups (20.3% vs. 6.5%, $p<0.01$), and among heavy smokers than non-smokers (23.2% vs. 10.8%, $p<0.05$).

There was a positive association between the extent of tooth loss and the extent of attachment loss ≥3 mm and ≥5 mm (Fig. 2). Hence, higher percentages of subjects with extensive tooth loss had attachment loss than subjects with little or no tooth loss, and a similar association was noted for analysis of individual teeth. Also a higher percentage of subjects with decayed/filled teeth were seen among the groups with the more extensive tooth loss than those with little or no tooth loss (Fig. 3).

The multivariable analysis showed that subjects in the low and middle socioeconomic status groups, respectively, were more likely to have one or more missing teeth than subjects in the high socioeconomic status group (Table 2). The likelihood of having missing teeth was also signifi-

TABLE 1
Percentage of subjects with tooth loss and mean tooth loss, by demographic, socioeconomic and behavioral characteristics

		% Subjects with tooth loss			Mean tooth loss		
	No.	%	SE	p	Mean	SE	p
Age group							
14 – 19	263	26.2	2.5		0.6	0.1	
20 – 24	180	49.1	5.7	0.01	1.4	0.3	0.03
25 – 29	169	60.2	5.0	0.001	2.4	0.6	0.01
Gender							
Male	291	43.5	3.4		1.4	0.2	
Female	321	46.1	2.3	0.39	1.5	0.3	0.44
Race							
White	507	46.6	3.4		1.6	0.3	
Non-white	105	36.2	5.2	0.20	0.9	0.2	0.1
Socioeconomic status							
Low	178	55.2	4.9		2.1	0.5	
Middle	190	42.3	2.6	0.03	1.2	0.1	0.07
High	244	33.5	2.0	0.01	0.8	0.1	0.03
Smoking status							
Non-smokers	396	40.5	2.0		1.2	0.2	
Light	72	40.4	6.8	0.98	1.1	0.4	0.78
Moderate	76	50.1	6.5	0.15	1.8	0.5	0.15
Heavy	68	62.6	3.4	0.001	2.3	0.5	0.02

* SE: Standard error

cantly higher in heavy smokers than in non-smokers. Furthermore, subjects with ≥2 decayed/filled teeth, or having ≥2 teeth with attachment loss ≥5 mm were significantly more likely to have missing teeth compared to subjects with ≤1 decayed/filled teeth or ≤1 teeth with attachment loss ≥5 mm, after adjusting for age, socioeconomic status, and smoking behavior (Table 3).

Discussion

This survey found a relatively high occurrence of tooth loss in this young urban south Brazilian population. Forty-five percent of the subjects had lost at least one permanent tooth, and the mean tooth loss was 1.4 teeth. Tooth loss increased sharply after the age of 20 years, and was significantly associated with low socioeconomic status and heavy cigarette smoking. After controlling for the effects of socioeconomic variable and smoking, the study showed that young subjects who had 2 or more decayed/filled teeth and subjects with 2 or more teeth with ≥5 mm attachment loss had significantly higher likelihood of having tooth loss than subjects with fewer or no teeth showing caries experience or attachment loss.

A survey conducted in 1986 examined populations in several large Brazilian cities and reported a mean of 1.2 missing teeth in the age group 15-19 years (15). In the present study there were 0.5 missing teeth in the corresponding age group. The difference in the number of missing teeth between the two studies may be due in part to a potential temporal change in the dental status of the Brazilian population in recent years. For instance, a significant decline in caries experience has been shown during the past two decades in the Brazilian state Rio Grande do Sul (23), and this may have contributed to a decline in the level of tooth loss. Another likely reason for the difference in results includes a difference in study design between the two studies.

A national survey of the US population estimated that the mean tooth loss in the age groups 18-24 and 25-29 years was 0.9 and 2.0 teeth, respectively (3). A national survey of the UK population estimated the tooth loss in 16-24 years old subjects to be 4.3 teeth (5). In this Brazilian population the mean tooth loss in the age groups 16-24, 18-24, and 25-29 years was 1.1, 1.2, and 2.4 teeth, respectively. Hence, the population for this study seems to have similar tooth loss to that of the US population, and markedly lower than that of the UK population. Other studies in developed (4) and developing (9, 11) countries have reported significantly lower occurrence of tooth loss.

In 1982 the FDI published global goals for the desirable number of remaining teeth for the year 2000 (24). Accordingly, it was recommended that ≥85% of the subjects in the 18+ years age group have 28 teeth present. In this study, 73.3% of the 18-29 years age group had 28 teeth present. Given the young age of the study sample, our findings suggest that this FDI goal has not been achieved in this Brazilian population. And if circumstances do not change, it is reasonable to expect that the deviation from the recommended goal would further increase as this population ages.

There was no significant difference in the level of tooth loss between males and females in this population. This is in agreement with similar findings in the US population aged 18 to 29 years (3), but is in contrast to several other studies that have reported a higher level of tooth loss in females than in males (1, 2, 5, 11, 25). The authors also found a tendency towards a higher number of missing teeth in whites than non-whites, although the difference was not statistically significant. A large survey of the US population aged 25-29 years reported similar levels of tooth loss among African-Americans, Hispanics, and whites (3).

TABLE 2
Multivariable analysis of the association of demographic, socioeconomic, behavioral and the occurrence of tooth loss in 14-29 years old subjects. Subjects without tooth loss are the comparison group.

		≥1 missing teeth		≥4 missing teeth	
Risk indicators	Group	OR	95% CI	OR	95% CI
Age 14 - 19	1.0		1.0		
	20 - 24	2.6*	1.3 - 5.2	3.5	0.8 - 16.0
	25 - 29	3.9†	2.2 - 6.8	6.0†	2.6 - 13.9
Socioeconomic level	High	1.0		1.0	
	Middle	1.6*	1.1 - 2.4	2.3	1.0 - 5.4
	Low	2.3†	1.4 - 3.7	4.2†	1.9 - 9.4
Smoking	Non-smoker	1.0		1.0	
	Light	1.0	0.6 - 1.6	0.8	0.2 - 3.2
	Moderate	1.1	0.6 - 1.9	1.3	0.4 - 4.0
	Heavy	1.5*	1.1 - 2.1	2.2*	1.2 - 3.8

*p< 0.05
†p< 0.01

TABLE 3
Multivariable analysis of the association of decayed/filled teeth and attachment loss with the occurrence of tooth loss in 14-29- year-old subjects. Subjects without tooth loss are the comparison group. Each estimates is adjusted for age, socioeconomic status, and smoking.

	Number of	≥1 missing teeth		≥4 missing teeth	
Risk indicators	teeth affected	OR	95% CI	OR	95% CI
Decayed/filled	≤ 1 tooth	1.0		1.0	
	≥ 2 teeth	2.9†	1.6 - 5.2	4.0*	1.3 - 12.4
Attachment loss ≥ 5 mm	≤1 tooth	1.0			1.0
	≥ 2 teeth	2.2*	1.0 - 4.7	3.5*	1.2 - 10.4

*p< 0.05
†p< 0.01

The results of this study showed that socioeconomic status was significantly associated with tooth loss after adjusting for important covariates. This is in agreement with other studies showing significant association of tooth loss with economic status (2, 13, 14, 25) and education (1, 2, 8, 25, 26). Of these two factors, the level of education has been shown to strongly influence the decision to extract teeth (27). Hence, subjects with higher level of education and better economic may be more likely to consider retaining their teeth, as well as being able to afford more conservative dental treatment. In addition, the authors found a significant association between tooth loss and heavy smoking, which is consistent with findings in other studies (1, 2, 13, 25, 28). Smoking is a significant risk factor for attachment loss (29), and this may explain its association with tooth loss.

The authors also investigated the association of tooth loss with caries experience and attachment loss using an analytical model that controlled for the effect of age, socioeconomic status, and smoking behavior. The results suggest that tooth loss is significantly more likely in subjects who had two or more teeth with caries experience and/or attachment loss ≥5 mm. Hence, tooth loss in this age group is an indicator of poor oral health. On the other hand, the findings may also suggest that caries experience and attachment loss are associated with increased risk for tooth loss in young people.

This survey is among a very few studies that have employed valid epidemiological study design to study the prevalence and risk factors of tooth loss in the Brazilian population. The findings indicate that tooth loss is a dental health concern in this young Brazilian population. In young subjects tooth loss is caused mainly by dental caries, and to a lesser extent by periodontal diseases. Low socioeconomic status and smoking behavior are important risk factors for tooth loss, as well as for other systemic diseases. A multidisciplinary, community- or school-based approach is essential to improve the oral and systemic health in this and other similar populations. Such programs should target low-income communities and should implement primary and secondary prevention by providing better awareness and knowledge of the etiology of oral and systemic diseases and proper methods of preventing these diseases. Targeting exposures that also are risk factors for systemic diseases may have a better chance of success, and may also enhance the benefits and effectiveness of public health interventions (30).

FIGURE 1
Percentage of subjects with tooth loss, by tooth type

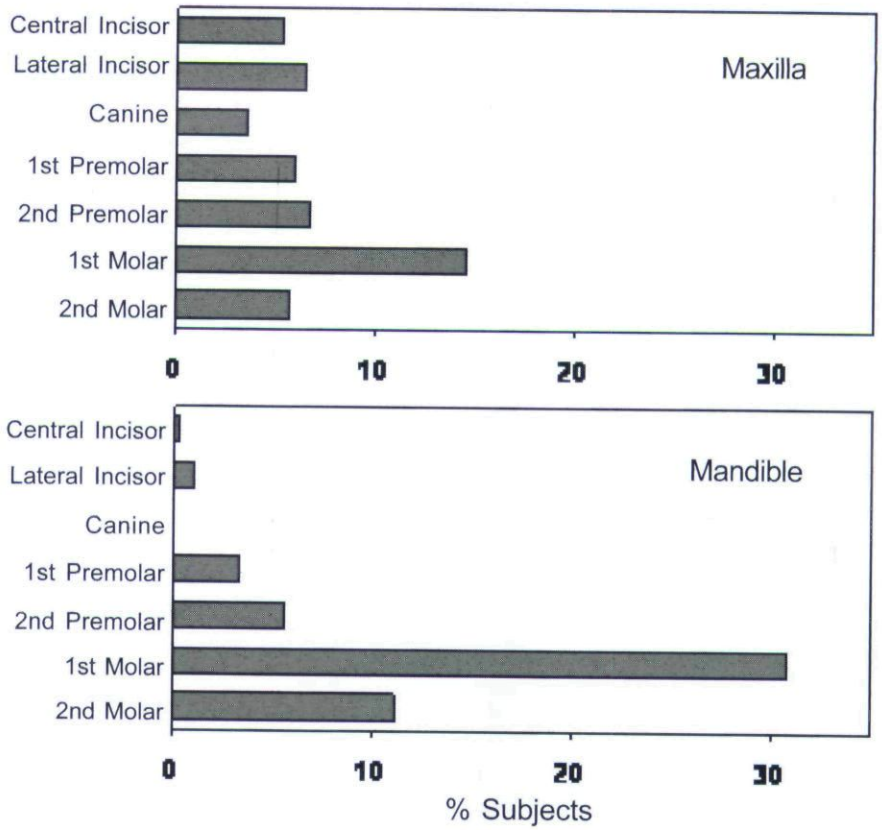

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FIGURE 2
Percentage of subjects and teeth with clinical attachment loss, by extent of tooth loss

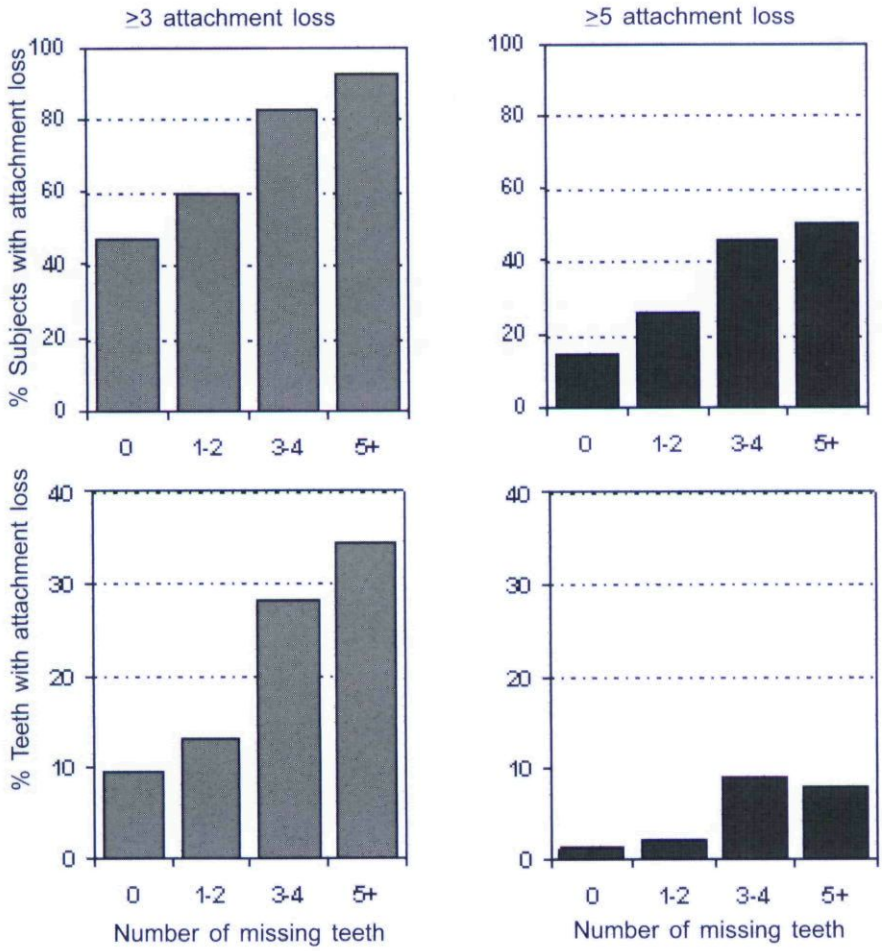
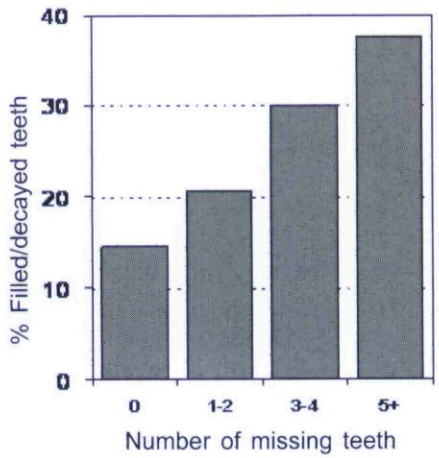


FIGURE 3
Percentage of subjects and teeth with decayed/filled teeth, by extent of tooth loss



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