IN BRIEF

- Enables the reader to appreciate the change in oral hygiene and gingival health that occurs between early adolescence and adulthood.
- Highlights some of the factors that might affect the standard of oral hygiene practised and the amount of gingivitis observed.

The Cardiff dental survey: oral hygiene and gingival health between the ages of 11-12 and 30-31 years

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Objective To examine oral hygiene and gingival health in relation to ageing in the second and third decades.

Design Cohort study.

Setting Cardiff, 1981, 1984, 1989 and 2000.

Subjects and methods Three hundred and thirty-seven subjects were examined at the ages of 11-12 and 30-31 years and 250 at baseline and all follow-up examinations; plaque and bleeding on probing were recorded.

Results Oral hygiene and gingival health improved as subjects moved through adolescence to adulthood. In general, females demonstrated less plaque and gingivitis than males. Whole mouth mean plaque and bleeding scores were lower at age 30-31 than 11-12. In those subjects examined on all four occasions, a switch from buccal to lingual predominance in the distribution of plaque and gingivitis occurred between 11-12 and 15-16 years. Oral hygiene and gingival health at 30-31 were statistically significantly associated with these parameters at previous examinations but this association became weaker as the interval between the two examinations lengthened.

Conclusions Although oral hygiene and gingival health improve between adolescence and adulthood, individual practices are established at a relatively early age. In encouraging adolescents and young adults to improve standards of oral hygiene, emphasis should be placed on the importance of brushing lingual surfaces.

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INTRODUCTION

Epidemiological and experimental data have long shown plaque to be the major aetiological factor in the initiation of chronic adult gingivitis.[1,2] Hence, periodontal diseases have their origins in childhood and adolescence.

Over the last decade, a small number of longitudinal studies conducted in Europe have examined changes in oral hygiene and gingival health between adolescence and adulthood. Crossner and Unell,[3] in a study of dental health in a group of teenagers/young adults, showed that between the ages of 14 and 25 gingival inflammation changed from being merely a result of poor oral hygiene to being an indication of initial periodontal disease. By the age of 25 years, this disease had manifested itself as bleeding on probing in almost 100% of subjects. In this study, males consistently showed a higher degree of gingival inflammation than females, though this gender difference was only statistically significant at the age of 19 years. Hugoson and Laurell[4] showed that, in individuals examined at the ages of 15 and 32 years, there was a tendency for plaque scores to decrease with age, though the difference was not statistically significant. In contrast, the percentage of individuals with a gingivitis score of 20% or less decreased from 56 to 35 over the 17-year period, while the percentage of individuals with high gingivitis scores (40% or more) increased from 15 to 30.

In the United Kingdom, 1981 saw the commencement of a cohort study,[5] the main aim of which was the evaluation of the long-term interrelationships between malocclusion, caries and periodontal disease. The cohort was followed up in 1984, 1989 and 2000, over which period there were inevitably losses to follow-up. In 1988, however, we were able to report data for 721 South Wales school children examined at the ages of 11-12 and 15-16 years,[6] showing that mean total plaque and bleeding scores were clinically significantly lower at age 15-16 than at 11-12. Likewise, in 1994, we reported data collected from 405 of these subjects who presented for re-examination at

Table 1 Group 1 – baseline periodontal characteristics by presentation for examination in 2000

	Male	Female	Whole mouth mean plaque score 1981 (SD)	Whole mouth mean bleeding score 1981 (SD)
Present in 2000 (n = 337)	146	191	1.15 (0.39)	0.53 (0.19)
Absent in 2000 (n = 678)	361	317	1.25 (0.41)	0.56 (0.20)

Table 2 Group 1 – baseline (1981) social class by availability for examination in 2000

	Examined in 2000 (n = 337)	Not examined in 2000 (n = 679)	Total (n = 1016)*	Dropout (%)
Social class I	22	34	56	60.7
Social class II	83	111	194	57.2
Social class IIIN	45	79	124	63.7
Social class IIIM	108	154	262	58.8
Social class IV	20	35	55	63.6
Social class V	14	19	33	57.6
Unemployed	45	118	163	72.4

* Baseline social class data missing for 129 subjects

age 19-20 years.[7] This later paper showed that the decrease in plaque and gingivitis observed between the ages of 11-12 and 15-16 years continued as the subjects moved towards adulthood. Gender appeared to be an important determinant of the standard of oral hygiene practised, males having consistently poorer oral hygiene than females. At the commencement of adolescence, this was not reflected in higher gingivitis scores, but by the age of 15-16 years, the males exhibited significantly more gingivitis than did the females.

In 2000, 337 members of the cohort presented for re-examination, providing an opportunity to examine the changes in oral hygiene and gingivitis which occurred between adolescence and early adulthood in two groups of subjects:

- Group 1 – 337 subjects examined at the ages of 11-12 and 30-31 years
- Group 2 – 250 subjects examined at the ages of 11-12, 15-16, 19-20 and 30-31 years.

SUBJECTS AND METHODS

Ethical approval was granted by the local Research Ethics Committee for all stages of the study. The strategy for investigation has been published previously.[5] In brief:

In 1981, access was granted to 23 of 29 South Glamorgan Education Authority Secondary Schools in Cardiff, Barry and Penarth. Combined information/consent letters were issued to the parents of all 4,810 first form pupils listed. Consent to participate was denied for 390 children (8.1%) and 651 (13.6%) were absent from school at the time of screening. Non-Caucasian children (163, 3.4%) and those already wearing orthodontic appliances (186, 3.9%) were excluded. This yielded 3,420 potential subjects for the study.

Criteria developed to identify various occlusal conditions of specific interest to the study were applied to the available population of 3,420 children. Details of these screening criteria are discussed fully in the strategy for investigation.[5] One thousand and sixteen children were finally recruited to the study by disproportionate stratified sampling.[8] This methodology ensured that occlusal conditions of low prevalence but high orthodontic interest would be adequately represented.

Table 3 Group 1 – whole mouth mean plaque and bleeding scores by gender 1981 and 2000

	Male (n = 146)	Female (n = 191)	Total (n = 337)
Mean plaque (SD) 1981	1.23 (0.38)	1.09 (0.39)	1.15 (0.39)
Mean plaque (SD) 2000	0.78 (0.42)	0.68 (0.44)	0.72 (0.43)
Mean change (SD) 1981–2000	-0.45 (0.49)	-0.41 (0.51)	-0.43 (0.50)
Mean bleeding (SD) 1981	0.55 (0.18)	0.52 (0.19)	0.53 (0.19)
Mean bleeding (SD) 2000	0.22 (0.17)	0.21 (0.17)	0.22 (0.17)
Mean change (SD) 1981–2000	-0.33 (0.22)	-0.30 (0.24)	-0.31 (0.23)

Plaque present at the gingival margin of the buccal and lingual aspects of all permanent teeth was recorded using the plaque index of Silness and Löe.[9] Plaque was detected on a Williams round No. 14 periodontal probe gently passed along the gingival crevice from the distal to the mesial papilla of each tooth. The presence or absence of bleeding[10] from the buccal, mesial and lingual gingiva was noted after this procedure. A simple dichotomous scoring system was employed, in which 0 = no bleeding and 1 = bleeding.

Collection of periodontal data was, throughout, the responsibility of one individual (MA). On those few occasions during the four survey periods when this principal examiner was unavailable, an individual whose concordance with MA in the use of the relevant indices had been well established in the course of clinical trials was substituted. In order to ensure examiner reliability, 5-10% repeat examinations were undertaken at all stages.

The baseline examination was conducted in mobile dental units with standardised lighting and equipment; subsequent examinations were conducted under similarly standardised conditions at the University Dental Hospital, Cardiff.

Social class was ascribed at baseline and retained throughout the study. This was determined on the occupation of the head of the household (information collected by questionnaire) and in accordance with the Office of Population Censuses and Surveys (1980) classification of social class.[11]

Statistical methods

At each visit each subject's whole mouth mean plaque score was derived by averaging the values from all scoreable sites. The whole mouth bleeding score was calculated as the proportion of scoreable sites showing any bleeding on probing. Similarly, mean plaque and bleeding scores were obtained for buccal, lingual and (in the case of bleeding) mesial sites. Associations between scores at baseline and at the three follow-up examinations were assessed by use of the Pearson correlation.

RESULTS

Group 1

Three hundred and thirty-seven (146 males and 191 females) of the original 1,016 subjects were examined in both 1981 and 2000. Baseline periodontal characteristics for these 337 subjects and for those who did not attend for re-examination in 2000 are presented in Table 1. It should be noted that complete gender and periodontal data were available for only 1,015 of the original 1,016 subjects.

Although the cohort originally comprised almost identical numbers of males and females, the follow-up rate was higher in females than in males (χ^2 = 8.9, p = 0.03). In addition, those 337 subjects followed up in 2000 had statistically significantly better baseline oral hygiene (p <0.001) and gingival health (p <0.01) than those who did not present for this examination.

Table 2 presents social class data for the 337 subjects who attended for re-examination in 2000 and for the 679 who did not. Statistical analyses show moderate evidence for a trend towards lower follow-up in lower social classes (χ^2 = 6.3, df = 1, p = 0.01) and, in particular, in the unemployed (χ^2 = 9.1, p = 0.002).

Summary statistics for plaque and bleeding at both time points are presented in Table 3. The whole mouth mean plaque score was higher in males than in females both in 1981 (p = 0.001) and 2000 (p = 0.04). It decreased by 37.3% (95% CI from 32.7% to 42.0%) from 1981 to 2000, with very similar, highly significant (p <0.001) percentage reductions in both genders. The whole mouth mean bleeding score was slightly higher in males than in females both in 1981 and 2000. It decreased by 59.2% (95% CI from 54.6% to 63.9%) from 1981 to 2000, with very similar, highly significant (p <0.001) percentage reductions in both genders.

Table 4 presents summary statistics for plaque and bleeding by gender and surface at both time points. At the initial examination in 1981, there were significant (p <0.001) differences between bleeding scores at the three sites (buccal, mesial and lingual), with more bleeding at buccal sites than at mesial or lingual ones. In 2000, there were again significant (p <0.001) differences between bleeding scores at the three sites. In contrast to 1981, however, bleeding scores were greater for

Table 4 Group 1 – mean plaque and bleeding scores by gender and site 1981 and 2000

	Male (n = 146)	Female (n = 191)	Total (n = 337)
Mean buccal plaque (SD) 1981	1.51 (0.53)	1.28 (0.55)	1.38 (0.55)
Mean buccal plaque (SD) 2000	0.62 (0.47)	0.51 (0.49)	0.55 (0.48)
Mean change (SD) buccal plaque 1981–2000	-0.89 (0.63)	-0.77 (0.66)	-0.82 (0.65)
Mean lingual plaque (SD) 1981	0.95 (0.32)	0.89 (0.32)	0.92 (0.32)
Mean lingual plaque (SD) 2000	0.94 (0.46)	0.85 (0.46)	0.88 (0.46)
Mean change (SD) lingual plaque 1981–2000	-0.15 (0.50)	-0.05 (0.50)	-0.34 (0.50)
Mean buccal bleeding (SD) 1981	0.61 (0.23)	0.55 (0.25)	0.58 (0.24)
Mean buccal bleeding (SD) 2000	0.17 (0.17)	0.15 (0.16)	0.16 (0.17)
Mean change (SD) buccal bleeding 1981–2000	-0.44 (0.25)	-0.40 (0.28)	-0.42 (0.27)
Mean mesial bleeding (SD) 1981	0.53 (0.24)	0.50 (0.26)	0.51 (0.254)
Mean mesial bleeding (SD) 2000	0.15 (0.17)	0.13 (0.19)	0.14 (0.18)
Mean change (SD) mesial bleeding 1981–2000	-0.38 (0.26)	-0.36 (0.31)	-0.37 (0.29)
Mean lingual bleeding (SD) 1981	0.50 (0.18)	0.50 (0.17)	0.50 (0.18)
Mean lingual bleeding (SD) 2000	0.34 (0.24)	0.35 (0.23)	0.35 (0.23)
Mean change (SD) lingual bleeding 1981–2000	-0.15 (0.29)	-0.15 (0.28)	-0.15 (0.28)

Table 5 Group 2 – baseline (1981) periodontal characteristics by availability of complete follow-up data

	Complete follow-up data available (n = 250)	Complete follow-up data unavailable (n = 765)
Male	110	396
Female	140	368
Gender data missing	0	1
Plaque		
Mean buccal (SD)	1.36 (0.54)	1.51 (0.56)
Mean lingual (SD)	0.89 (0.32)	0.97 (0.34)
Mean total (SD)	1.12 (0.39)	1.24 (0.41)
Bleeding		
Mean buccal (SD)	0.58 (0.24)	0.61 (0.25)
Mean mesial (SD)	0.50 (0.25)	0.55 (0.25)
Mean lingual (SD)	0.50 (0.18)	0.52 (0.19)
Mean total (SD)	0.53 (0.19)	0.56 (0.20)

lingual sites. Similarly, the distribution of plaque was predominantly buccal in 1981, but predominantly lingual in 2000 (both p <0.001).

Plaque and bleeding scores were strongly associated, both in 1981 (r = +0.78, p <0.001) and 2000 (r = +0.74, p <0.001). In addition, scores in 1981 were weakly predictive of those in 2000, both for plaque (r = +0.27, p <0.001) and bleeding (r = +0.18, p <0.001).

Group 2

Plaque and bleeding scores were available for 250 individuals (110 males and 140 females) who attended all four examinations. Given the low retention rate, an attrition analysis is again appropriate. Table 5, therefore, presents baseline periodontal characteristics by availability of follow-up data. Baseline plaque scores for the 250 subjects who attended on all four occasions were significantly lower than for the 765 who did not present for complete follow-up (plaque p <0.001, bleeding p = 0.014 by either t or Mann-Whitney test), though these differences were not very large in clinical terms.

Table 6 presents baseline socio-demographic characteristics by availability of follow-up data. A higher proportion of those who attended all four examinations were female (χ^2 = 4.6, p = 0.03), while a lower proportion came from families classed as unemployed (χ^2 = 6.3, p = 0.01).

Summary statistics for plaque in 250 subjects at baseline and at the three subsequent examinations are presented in Table 7. Across the four visits there was a marked reduction in buccal plaque. At lingual sites, however, while a small reduction in plaque score was observed between 1981 and 1984, the values at the third and fourth examinations were close to that found at baseline. Buccal plaque expressed as a percentage of the total reduced steadily from 59% in 1981 to 35% in 2000. Consequently, a switch from buccal to lingual predominance had occurred at around the time of the first follow-up examination at age 15-16.

The mean total plaque score at age 30-31 (2000) was highly significantly associated (p <0.001) with the same variable at each previous examination. As expected, however, this association became weaker as the interval between the two examinations lengthened (1989 r = 0.50, 95% CI 0.40 to 0.59; 1984 r = 0.36, 95% CI 0.25 to 0.46; 1981 r = 0.32, 95% CI 0.20 to 0.42). Considering the short time interval involved, the correlation between plaque scores at ages 11-12 and 15-16 was relatively weak (r = 0.45, 95% CI 0.35 to 0.55), but highly statistically significant.

Summary statistics for bleeding in 250 subjects at baseline and at the three subsequent examinations are presented in Table 8, while in Table 9 we present bleeding at buccal, lingual and mesial sites as percentages of the total, based on 225 subjects who had non-zero total bleeding scores at all four visits. At age 11-12, bleeding scores were fairly evenly distributed across buccal, lingual and mesial sites. There was a marked decrease to ages 15-16 and 19-20 at all sites. Subsequently, bleeding increased somewhat to age 30-31, especially for lingual sites. A steady shift towards lingual predominance first became evident around the time of the first follow-up examination at age 15-16.

As with plaque, the mean total bleeding score at age 30-31 was found to have a moderate to weak (but highly significant) association with the same variable at all three previous examinations. As was observed in relation to the mean total plaque score, this association weakened as the interval between examinations lengthened (1989 r = 0.39, 95% CI 0.27 to 0.49; 1984 r = 0.31, 95% CI 0.19 to 0.42; 1981 r = 0.22, 95% CI 0.10 to 0.34). All patterns noted were similar in nature in the two genders.

Table 6 Group 2 – baseline (1981) social class by availability of complete follow-up data

	Complete follow-up data available (n = 250)	Complete follow-up data unavailable (n = 765)	Total (n = 1016)*	Dropout (%)
Social Class I	16	40	56	71.43
Social Class II	58	136	194	70.10
Social Class IIIN	34	90	124	72.58
Social Class IIIM	82	180	262	68.70
Social Class IV	16	39	55	70.91
Social Class V	11	22	33	66.66
Unemployed	33	130	163	79.75

* Baseline social class data missing for 129 subjects

Table 7 Group 2 – progression of mean plaque scores in 250 subjects from age 11-12 through age 30-31

	Male (n = 110)	Female (n = 140)	Total (n = 250)
Mean buccal (SD)			
1981	1.44 (0.54)	1.29 (0.54)	1.36 (0.54)
1984	0.92 (0.64)	0.66 (0.49)	0.78 (0.57)
1989	0.72 (0.48)	0.55 (0.45)	0.62 (0.47)
2000	0.61 (0.48)	0.48 (0.47)	0.54 (0.48)
Mean lingual (SD)			
1981	0.90 (0.33)	0.88 (0.31)	0.89 (0.32)
1984	0.75 (0.38)	0.73 (0.38)	0.73 (0.38)
1989	0.90 (0.40)	0.84 (0.42)	0.84 (0.42)
2000	0.91 (0.47)	0.86 (0.47)	0.86 (0.47)
Mean buccal as % of mean total (SD)			
1981	60.8 (9.3)	58.2 (10.4)	59.4 (10.0)
1984	51.3 (16.2)	45.5 (15.4)	48.0 (16.0)
1989	42.3 (14.8)	38.2 (16.9)	40.0 (16.1)
2000	36.9 (15.0)	33.1 (17.8)	34.8 (16.7)

DISCUSSION

Over the period 1981-2000, the original cohort of 1,016 subjects suffered considerable losses to follow-up. It should, however, be emphasised that the sample size is still large for a survey of this kind and the resultant data are unique.

The data presented in Tables 1, 2, 5 and 6 are unsurprising and do not in any way imply that the follow-up analyses presented here are flawed. Indeed, it would be totally anomalous for there to be conflicting trends amongst those not followed up *vis à vis* those who were and for these to be of such magnitude as to result in no net change in the complete cohort. To verify this assertion, counterfactual means were reconstructed based on the results for Group 1. This exercise showed that, for there to have been zero net change from 1981 to 2000 based on all 1,015 subjects, the whole mouth mean plaque score for the 678 subjects who did not attend in 2000 would have had to have increased from 1.25 to 1.46. Likewise, the whole mouth

mean bleeding score would have had to have increased from 0.564 to 0.719. This would mean that the 678 subjects who did not attend for re-examination would have needed to have displayed twice the amount of plaque and more than three times the amount of bleeding found in the 337 subjects who did attend. While it is impossible to state categorically that this could not possibly be the case, it is highly implausible that a cohesive cohort would have split in such a way.

The results for Group 1 clearly show that, over the 19-year period, whole mouth plaque and bleeding scores reduced significantly in both males and females. Likewise, both oral hygiene and gingival health improved as the subjects who attended all four examinations moved through adolescence to adulthood. In general, females had less plaque and gingivitis than males, a finding which has been reported previously[3,7] and which reflects the greater grooming habits of females relative to those of males.[12-18]

The results for Group 2 show that the most striking improvements in both oral hygiene and gingival health occurred in the early years of adolescence (between the ages of 11-12 and 15-16 years), those improvements made during the latter years of adolescence and the early adult years being considerably smaller. It is tempting to attribute this observation to the fact that the onset of puberty occurs during these early years of adolescence since this developmental milestone has been suggested as being associated with an increase in gingivitis, particularly in females.[18] The evidence linking gingivitis with puberty is, however, equivocal. In a previous longitudinal study of adolescents aged 11-17 years,[19] a dramatic increase in gingivitis, not accompanied by similar changes in oral hygiene, occurred around puberty. It was suggested that this represented an increased tissue response to local factors, linked to the hormonal changes occurring at this time. More recent studies have failed to replicate this finding, low levels of gingivitis being observed in pubertal children who demonstrate good oral hygiene and low plaque scores. For example, in a study of 14-year-old Finnish school children,[20] no association was found between the occurrence of gingival bleeding and the increasing levels of steroid hormones. The authors concluded that, with respect to gingival bleeding, oral hygiene was more important than the stage of puberty. The years immediately following the onset of puberty are, at least subjectively, marked by the establishment of a more positive attitude to various aspects of personal hygiene. It is, therefore, likely that the improvements in oral hygiene and gingival health in this cohort reflect an improvement in the subjects' approach to grooming in general and oral hygiene in particular.

With respect to the distribution of plaque by tooth surface, a significant change may be observed over the 19-year period. In both groups, there was a baseline trend for there to be more plaque on the buccal surface than on the lingual, but by 2000 this trend was reversed. Data collected from Group 2 shows this process in more detail: while oral hygiene on the buccal surfaces showed a steady improvement, the mean lingual plaque score improved in the early years of adolescence and then began to deteriorate as the subjects reached adulthood. This observation undoubtedly reflects the limited attention that most individuals give to brushing these surfaces; indeed, it has been shown that less than ten percent of brushing time is devoted to lingual areas.[21,22]

The same pattern of change may be noted in relation to buccal and lingual bleeding, an observation that, given the degree of correlation between the two variables, is to be expected.

In Group 1, baseline plaque and bleeding scores were predictive of those in 2000 ($p < 0.001$). Likewise, in Group 2, both mean total plaque and mean total bleeding scores throughout adolescence showed statistically highly significant ($p < 0.001$) associations with the same parameters at age 30-31 years. The reader should, however, be aware that weak correlations can easily reach high levels of statistical significance on a very large sample size.

In Group 2, plaque and bleeding scores at age 19-20 years were, perhaps not surprisingly, more valuable as a predictor of oral hygiene and gingival health in early adulthood than those at earlier stages in adolescence. It has been noted that, considering the short time interval involved, the correlation between plaque scores at ages 11-12 and 15-16 was relatively

Table 8 Group 2 – progression of mean bleeding scores in 250 subjects from age 11–12 through age 30–31

	Male (n = 110)	Female (n = 140)	Total (n = 250)
Mean buccal (SD)			
1981	0.59 (0.23)	0.56 (0.25)	0.58 (0.24)
1984	0.29 (0.24)	0.19 (0.17)	0.24 (0.21)
1989	0.18 (0.19)	0.13 (0.14)	0.15 (0.17)
2000	0.18 (0.18)	0.14 (0.15)	0.15 (0.17)
Mean mesial (SD)			
1981	0.49 (0.24)	0.51 (0.26)	0.50 (0.25)
1984	0.25 (0.23)	0.19 (0.18)	0.21 (0.20)
1989	0.12 (0.16)	0.10 (0.14)	0.11 (0.15)
2000	0.15 (0.17)	0.12 (0.19)	0.13 (0.18)
Mean lingual (SD)			
1981	0.48 (0.18)	0.51 (0.17)	0.50 (0.18)
1984	0.28 (0.16)	0.28 (0.17)	0.28 (0.17)
1989	0.29 (0.22)	0.25 (0.18)	0.27 (0.19)
2000	0.35 (0.25)	0.34 (0.22)	0.34 (0.24)
Mean total (SD)			
1981	0.52 (0.19)	0.53 (0.19)	0.53 (0.19)
1984	0.27 (0.18)	0.22 (0.15)	0.24 (0.170)
1989	0.19 (0.16)	0.16 (0.13)	0.18 (0.15)
2000	0.22 (0.18)	0.20 (0.17)	0.21 (0.17)

Table 9 Group 2 – progression of mean buccal/mesial/lingual bleeding scores as a percentage of mean total bleeding score in 225 subjects from age 11–12 through age 30–31

	Male (n = 98)	Female (n = 127)	Total (n = 225)
Mean buccal as % of mean total (SD)			
1981	37.8 (7.4)	34.5 (8.2)	35.9 (8.0)
1984	33.3 (12.3)	28.3 (14.3)	30.5 (13.7)
1989	31.1 (21.9)	27.5 (22.5)	29.1 (22.2)
2000	25.9 (18.6)	21.0 (16.2)	23.1 (17.4)
Mean mesial as % of mean total (SD)			
1981	30.5 (9.3)	30.6 (9.9)	30.5 (9.6)
1984	26.1 (14.7)	26.0 (16.3)	26.0 (15.6)
1989	15.1 (13.6)	14.2 (14.7)	14.6 (14.2)
2000	18.3 (13.5)	14.6 (15.3)	16.2 (14.6)
Mean lingual as % of mean total (SD)			
1981	31.8 (10.8)	34.9 (11.9)	33.5 (11.5)
1984	40.7 (19.9)	45.7 (20.9)	43.5 (20.6)
1989	53.8 (24.7)	58.3 (26.9)	56.3 (26.0)
2000	55.8 (22.6)	64.4 (23.0)	60.6 (23.2)

weak (r = 0.45, 95% CI 0.35 to 0.55). This observation implies that a considerable change in the ordering of different subjects took place. Determination of whether the levels of oral hygiene and gingival health achieved by the subjects as young adults are maintained as they approach middle age would necessitate a further follow-up examination, when further attrition of the sample size could be anticipated.

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