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ORIGINAL ARTICLE

Does having children affect women's oral health? A longitudinal study

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Abstract

Background: Many believe women's oral health deteriorates as a result of having children. If so, such associations should exist among women but not among men. The aims of this study were to investigate whether number of children is associated with experience of dental disease and tooth loss among both men and women and to examine whether this association is affected by other variables of interest.

Methods: This study used data from the Dunedin Multidisciplinary Health and Development study, a longitudinal study of 1037 individuals (48.4% female) born from April 1972 to March 1973 in Dunedin, New Zealand, who have been examined repeatedly from birth to age 45 years.

Results: Data were available for 437 women and 431 men. Those with low educational attainment were more likely to have more children and began having children earlier in life. Having more children was associated with experiencing more dental caries and tooth loss by age 45, but this association was dependent on the age at which the children were had. Those entering parenthood earlier in life (by age 26) had poorer dental health than those entering parenthood later in life, or those without children. There was no association between number of children and periodontal attachment loss (PAL). Low educational attainment, poor plaque control, never routine dental attendance, and smoking (for PAL) were associated with PAL, caries experience, and tooth loss.

Conclusions: Social factors associated with both the timing of reproductive patterns and health behaviors influence the risk of dental disease and its management.

Introduction

Many women believe that their dental condition is likely to deteriorate through having children, and that it is normal to lose teeth during or after pregnancy [1]. Despite the fact that pregnancy does not (and indeed cannot) directly cause calcium to be "drawn out" of the teeth [2], this continues to be a common belief [1]. Epidemiological studies have suggested an association between parity (the number of times a women has given birth) and dental conditions such as tooth loss [3–8], untreated dental caries [9], and periodontal attachment loss [10].

While causality for the association between parity and dental condition cannot be established on the basis of existing data, there are several plausible explanations for it. Pregnancy-related biological changes have been suggested as the link to onset and/or progression of dental disease. Estrogen has been shown to elicit heightened gingival inflammation; however, these changes are transient and reversible postpartum for most women [11–13]. It remains unclear whether hormonal-induced heightened gingival inflammation superimposed on pre-existing periodontitis contributes to progression of irreversible attachment loss, and there is a need for longitudinal research into this [14]. Pregnancy hormones may also induce changes to salivary gland function and/or saliva composition, repeated gastric reflux, reduced oral self-care or altered dietary habits, which might affect risk for dental disease [15], but whether dental caries increases during pregnancy is unknown.

Sociobehavioral factors may explain the association between parity and dental disease. It has been demonstrated that education and socioeconomic position (SEP) are important markers of a woman's fertility rate and timing of first birth [16]. Further, both dental caries and periodontal disease are associated with these factors [17,18]. Therefore, there is considerable potential for confounding by SEP (and associated differences in health-related behaviors) in any observed associations between parity and dental health.

Despite (a) the pervasive belief that pregnancy and parity are associated with tooth loss, and (b) there having been epidemiological reports of an association between parity and tooth loss, very few investigations have explored the mechanisms for this association [3]. The aims of this study were to investigate whether there was an association between parity and negative dental outcomes (periodontal attachment loss, caries, and tooth loss) and to identify social and behavioral risk factors common to both parity and poorer dental health that may account for any observed association. Analyses were conducted for both women and men to determine whether there were sex differences in any observed association.

Materials and methods

The Dunedin Multidisciplinary Health and Development Study (DMHDS) is a longitudinal birth cohort study of 1037 babies born at the Queen Mary Hospital, Dunedin, New Zealand between April 1, 1972 and March 31, 1973 [19]. The cohort were assessed at birth, within a month of their third birthdays, and then at regular intervals throughout childhood and adulthood (ages 5, 7, 9, 11, 13, 15, 18, 21, 26, 32, 38, and 45). At each phase of assessment, a broad range of health-related (including dental), developmental and social information was collected. This study utilizes data collected at age 26, 32, 38, and 45. Ethics approval for the study was granted by the Otago Research Ethics Committee, and participants gave informed consent.

Data for reproductive history were collected through a standardized computer-presented questionnaire, used at age 26, 32, 38, and 45. Participants were asked about pregnancies "ever" or "since the previous assessment," and for details of their age for each pregnancy (and the outcome).

A detailed description of the dental examination [20] and periodontal examination [21] has been previously reported. In brief, teeth were examined by registered, calibrated dentists using a dental mouth mirror with an explorer probe. Teeth were not dried prior to inspection, and radiographs were not taken. Each tooth was examined for caries and restorations; if it was missing since the last assessment, the participant was asked to recall the reason for its removal. Only teeth that had been lost due to caries were included in the current analysis and these were included as the missing ("M") component of the decayed, missing and filled tooth surfaces (DMFS) scores. Periodontal examinations excluded participants with a cardiac valve abnormality, a history of rheumatic fever with cardiac involvement, or a total joint replacement. Periodontal measurements were made at three sites (mesio-buccal, mid-buccal, and disto-lingual) of all teeth present, excluding third molars and carious retained roots, using a PCP-2 (Hu-Friedy) periodontal probe. Gingival recession (GR, the distance in mm from the cementoenamel junction to the gingival margin) and probing depth (PD, the distance from the tip of the periodontal probe to the gingival margin) were recorded, with measurements rounded down to the nearest whole millimeter. Periodontal attachment loss (AL) for each site was calculated at the analysis stage by adding the GR and PD measurements. The extent of AL was defined as the percentage of sites with 5+ mm [22].

The covariates included in the analysis were the highest level of education achieved, dental attendance, plaque index, and smoking (latter included only for periodontal analysis). Both level of education achieved and SEP were strong determinants of when a participant entered parenthood. Level of education achieved had a stronger association in these analyses because it had a stronger relationship with both the age at which a participant entered parenthood and the number of children they had. Furthermore, education may be a more useful measure for use with women, who are more likely to take career breaks while raising children.

For the purpose of these analyses, education was trichotomised as "low" (school certificate or less), "medium" (post-school certificate, but not university) and "high" (university-level qualification) [16]. SEP at age 45 was used for attrition analysis. SEP was defined using an updated version of the New Zealand Socioeconomic Index (a scale to rank occupation based on level of education and income) [23].

Each study member was asked "have you smoked every day for one month or more of the previous 12 months?" Those responding "yes" were classified as current smokers for that age. Never smokers were those who had never smoked continuously for a month or more, and all other participants (who had smoked on occasion) were defined as ex-smokers. Current and ex-smokers were also asked about the number of cigarettes smoked per day and the duration (in years) they had smoked at this rate. The cumulative number of pack years by each age was calculated for each study member.

Regular attenders were identified as those who usually visited for a check-up and had attended the dentist within the previous 12 months. A count of ages (26, 32, 38, and 45) at which participants self-identified as regular attenders was used to create a long-term attender variable. Those with a score of 0 were designated "never regular" attenders, those scoring 1 or 2 were "sometimes regular" attenders, and those with a score of 3 or 4 were considered "usually regular" attenders.

Oral hygiene was assessed using the Simplified Oral Hygiene Index [24]. A life-time plaque group score was calculated based on plaque scores taken from the ages of 5, 9, 15, 18, 26, and 32; this categorized participants' plaque control as poor, moderate, or good [25].

Statistical analyses were undertaken using Stata IC 15.1 (StataCorp 2017, Stata Statistical Software, College Station, TX, USA). The statistical significance of observed associations was tested by the Chi-square test for categorical variables and the MannWhitney U or Kruskal–Wallis tests for continuous variables with nonparametric distributions. The level of significance was set at 0.05. Negative binomial regression modeling was used to examine the association between parity and count dependent variables at age 45 (extent of AL, decayed tooth surfaces, DMFS, and mean number of missing teeth). These analyses adjusted for the highest level of education achieved, oral hygiene, and dental attendance. Smoking was also controlled for in the model for periodontal AL.

Results

At age 45, 896 (95.5%) study members were dentally examined, of whom 449 (49.9%) were women. A small number of participants were excluded (12 women, and 16 men) from analyses due to incomplete data, leaving 437 women, and 431 men for analysis (Figure 1). A further 25 women and 22 men were excluded because they declined periodontal examination, were medically contraindicated, or were edentulous. By age 45, 71 (16.2%), 209 (47.8%), and 157 (35.9%) of the included women—and 100 (23.2%), 197 (45.7%), and 134 (31.1%) of the included men—were categorized as being of low, medium, and high SEP, respectively. In our attrition analyses, SEP did not differ significantly between the included and excluded participants in the caries and tooth loss analyses,

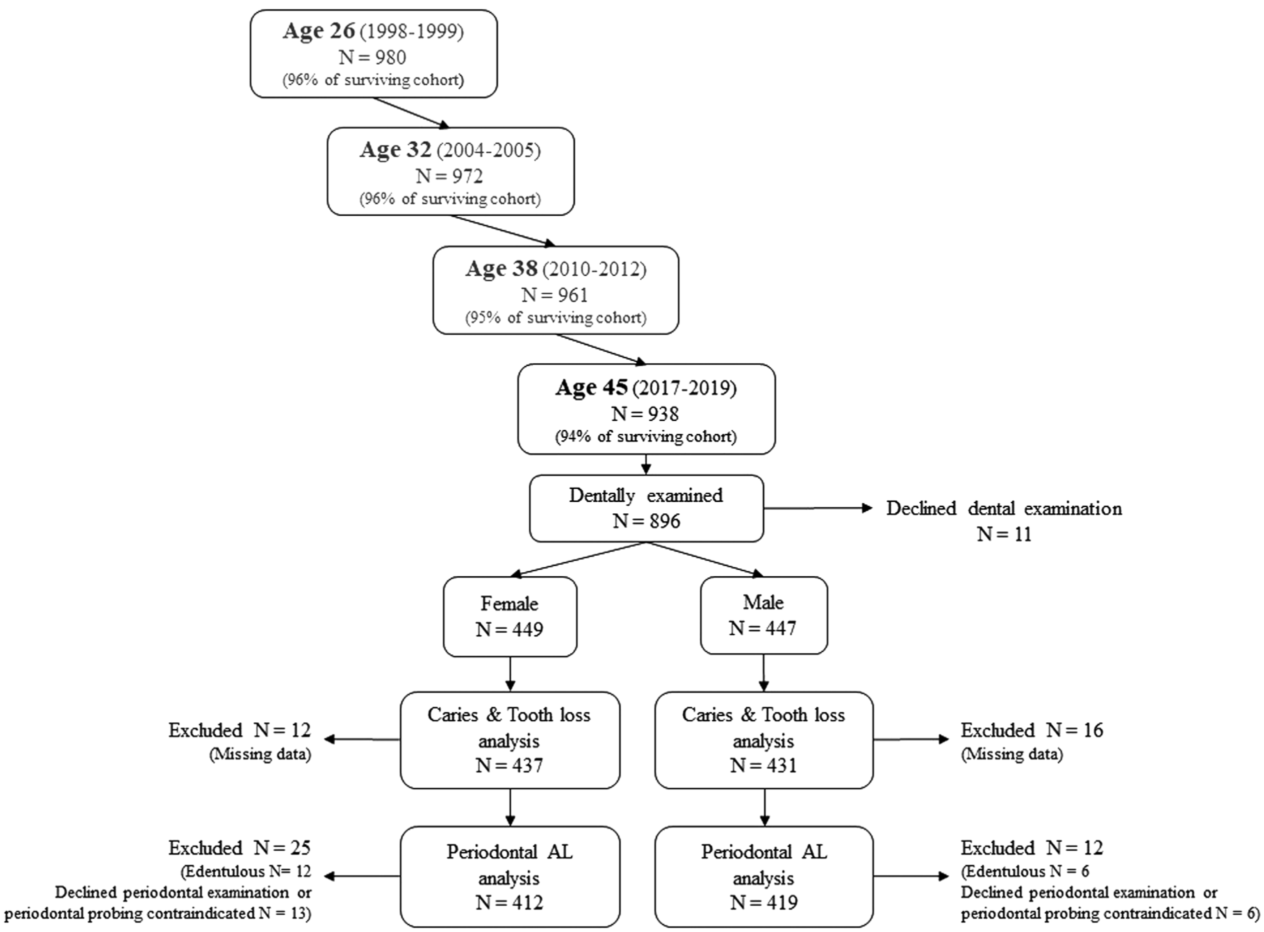

Figure 1 Flow diagram of participants at each phase of data collection, and excluded and included for analysis

Table 1 Mean number of children among male and female study members, by socio-demographic characteristics and smoking at ages 26, 32, 38 and 45

	Mean number of children (sd)							
	Female				Male			
	26	32	38	45	26	32	38	45
SEP								
Low	0.4 (0.6)[a,b]	1.2 (1.1)[a,b]	1.6 (1.2)	2.1 (1.2)[a]	0.4 (0.8)[a]	0.4 (0.7)[a,b]	1.5 (1.4)	1.8 (1.5)
Medium	0.2 (0.6)	1.0 (1.0)[c]	1.8 (1.2)[c]	1.8 (1.2)	0.3 (0.6)[c]	0.7 (1.0)	1.4 (1.2)	1.6 (1.3)
High	0.1 (0.3)	0.5 (0.8)	1.5 (1.1)	1.7 (1.2)	0.1 (0.4)	0.9 (1.3)	1.3 (1.1)	1.8 (1.1)
Education level								
Low	0.8 (0.9)[a,b]	1.5 (1.1)[a,b]	2.0 (1.2)[a,b]	2.1 (1.2)[b]	0.5 (0.9)[a,b]	1.0 (1.2)[a,b]	1.7 (1.3)[a,b]	1.8 (1.4)
Medium	0.3 (0.7)[c]	0.9 (1.0)[c]	1.6 (1.2)	1.7 (1.2)	0.2 (0.6)[c]	0.7 (1.0)[c]	1.3 (1.2)	1.6 (1.2)
High	0.0 (0.2)	0.6 (0.9)	1.6 (1.1)	1.8 (1.1)	0.0 (0.1)	0.4 (0.7)	1.3 (1.2)	1.7 (1.2)
Smoking								
Smoker[e]	0.6 (0.9)[d]	1.2 (1.1)[d]	1.8 (1.1)	1.9 (1.1)	0.5 (0.9)[d]	1.0 (1.3)[d]	1.7 (1.5)	1.9 (1.5)
Non-S	0.2 (0.6)	0.9 (1.0)	1.7 (1.2)	1.8 (1.2)	0.1 (0.4)	0.6 (0.9)	1.3 (1.1)	1.7 (1.2)
Routine dental attender								
Never	0.7 (0.9)[f,g]	1.2 (1.1)[f,g]	1.8 (1.2)[f]	1.9 (1.2)	0.5 (0.8)[f,g]	0.9 (1.2)[f,g]	1.6 (1.4)[f,g]	1.8 (1.4)
Sometimes	0.3 (0.7)[h]	0.9 (1.1)	1.7 (1.3)	1.8 (1.3)	0.2 (0.6)	0.6 (0.9)	1.3 (1.1)	1.6 (1.2)
Usually	0.1 (0.4)	0.7 (0.9)	1.5 (1.1)	1.7 (1.1)	0.1 (0.5)	0.5 (0.9)	1.2 (1.2)	1.6 (1.2)
Oral hygiene								
Poor	1.1 (1.0)[i,j]	1.7 (1.2)[i,j]	2.0 (1.2)	2.1 (1.2)	0.7 (1.0)[i,j]	1.2 (1.4)[i,j]	1.8 (1.5)[i]	2.1 (1.5)[i,j]
Moderate	0.4 (0.7)	1.1 (1.1)[k]	1.6 (1.2)	1.7 (1.1)	0.2 (0.6)	0.7 (0.9)[k]	1.4 (1.1)	1.6 (1.2)
Good	0.3 (0.6)	0.8 (1.0)	1.7 (1.2)	1.9 (1.2)	0.1 (0.4)	0.4 (0.9)	1.2 (1.3)	1.6 (1.2)

Note: Kruskal–Wallis test, post hoc Dunn test.

Abbreviations: Non-S, nonsmoker; sd = standard deviation.

[a] Sig. between low and high.

[b] Sig. between low and medium.

[c] Sig. between medium and high.

[d] Mann–Whitney U test.

[e] Current Smoker: Age 26: Female = 172, Male = 158. Age 32: Female = 118, Male = 137. Age 38: Female = 91, Male = 95. Age 45: Female = 84, Male = 94.

[f] Sig. between never and usually.

[g] Sig. between never and sometimes.

[h] Sig. between sometimes and usually.

[i] Sig. between poor and good.

[j] Sig. between poor and moderate.

[k] Sig. between moderate and good.

but a significantly greater proportion of participants of low SEP and current smokers had been excluded from the periodontal analyses.

One in four women and one in five men had entered parenthood by age 26, rising to roughly 80% by age 45. Low education attainment was associated with having more children at all ages for women, and all ages except age 45 for males (Table 1). Low SEP was associated with having more children at all ages, except for age 38 among women, and at age 38 and 45 among men. Smoking, poorer dental attendance, and poor oral hygiene were associated with having more children among women and men at age 26 and 32, but by age 45, these associations were no longer present.

Among both female and males, low SEP, low educational achievement, poor plaque control, nonroutine use of dental services and smoking (for AL) were all significantly associated with more extensive AL, untreated dental caries, higher DMFS scores, and tooth loss (Tables 2 and 3).

In the unadjusted model, parity by age 26 and parity by age 45 were associated, decayed tooth surfaces, DMFS and missing teeth. Parity by 26 was associated with periodontal AL, but not parity by age 45 (Table 2). Among men, fathering children by the age of 26 was associated with periodontal AL, decayed tooth surfaces, DMFS, and missing teeth. Although there were no significant dental differences by age 45 between men who had fathered children and those who had not.

After controlling for putative confounders, parity by 26 among females was associated with more dental disease experience by age 45 (count of tooth surfaces with untreated decay (IRR 1.64, 95% CI 1.18–2.28), DMFS

Table 2 Negative binominal regression modeling for periodontal attachment loss, decayed tooth surfaces, DMFS, and missing teeth (age 45) by parity (age 26), among females ($N = 437$)

	Periodontal AL[a]		Decayed tooth surfaces		DMFS		Missing teeth	
	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)
Number of children								
By 26	**1.59 (1.03, 2.47)**	0.93 (0.66, 1.32)	**2.03 (1.42, 2.91)**	**1.64 (1.18, 2.28)**	**1.41 (1.25, 1.60)**	**1.24 (1.10, 1.41)**	**2.13 (1.60, 2.84)**	**1.56 (1.22, 2.00)**
Between 26 and 45	0.78 (0.61, 1.00)	0.81 (0.65, 1.02)	**0.71 (0.56, 0.88)**	0.94 (0.74, 1.18)	**0.92 (0.85, 0.99)**	1.03 (0.96, 1.12)	**0.78 (0.65, 0.92)**	1.09 (0.93, 1.28)
Education level (Ref Low)								
Medium	**0.30 (0.15, 0.60)**	0.95 (0.50, 1.80)	0.66 (0.35, 1.27)	0.91 (0.49, 1.70)	**0.59 (0.47, 0.73)**	0.81 (0.65, 1.01)	**0.26 (0.16, 0.41)**	**0.54 (0.35, 0.83)**
High	**0.30 (0.15, 0.59)**	**0.53 (0.28, 0.99)**	**0.24 (0.12, 0.47)**	**0.36 (0.18, 0.75)**	**0.45 (0.36, 0.56)**	**0.67 (0.53, 0.85)**	**0.12 (0.08, 0.20)**	**0.30 (0.19, 0.47)**
Dental characteristics								
Plaque group (Ref Good)								
Moderate	**2.46 (1.43, 4.24)**	1.08 (0.65, 1.78)	**4.07 (2.35, 7.04)**	**2.56 (1.47, 4.46)**	**1.56 (1.31, 1.86)**	**1.36 (1.13, 1.62)**	**3.30 (2.24, 4.84)**	**2.14 (1.48, 3.12)**
Poor	**10.49 (2.57, 42.79)**	**9.91 (3.00, 32.68)**	**5.68 (1.92, 16.85)**	**4.16 (1.45, 11.93)**	**3.42 (2.38, 4.91)**	**2.47 (1.69, 3.60)**	**15.26 (7.28, 32.02)**	**6.14 (3.08, 12. 24)**
Routine dental attender (Ref Never)								
Sometimes	**0.38 (0.21, 0.70)**	0.67 (0.38, 1.12)	**0.38 (0.21, 0.68)**	0.64 (0.36, 1.16)	0.82 (0.67, 1.01)	1.08 (0.89, 1.32)	**0.45 (0.29, 0.70)**	0.75 (0.51, 1.10)
Usually	**0.10 (0.05, 0.19)**	**0.38 (0.18, 0.80)**	**0.19 (0.09, 0.38)**	**0.27 (0.13, 0.55)**	**0.56 (0.44, 0.71)**	0.89 (0.70, 1.13)	**0.10 (0.06, 0.18)**	**0.27 (0.16, 0.45)**
Smoking								
Cumulative pack yrs	**1.11 (1.07, 1.14)**	**1.10 (1.06, 1.13)**						
Log likelihood	−609.56		−440.74		−1814.53		−660.35	

Note: Bold denotes statistical significance, $p < 0.05$.

Abbreivations: AL, periodontal attachment loss; DMFS, decayed, missing, filled tooth surfaces; IRR, incidence rate ratio.

[a] Periodontal AL $N = 412$.

[b] This is interpreted as the estimated rate ratio for one unit increase of the predictor variable while holding all other variables in the model constant.

Table 3 Negative binominal regression modeling for periodontal attachment loss, decayed tooth surfaces, DMFS and missing teeth (age 45) by number of children had (age 26), among males ($N = 431$)

	Periodontal AL[a]		Decayed tooth surfaces		DMFS		Missing teeth	
	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)	Unadjusted IRR[b] (95% CI)	Adjusted IRR[b] (95% CI)
Number of children								
By 26	**2.06 (1.46, 2.92)**	1.32 (0.99, 1.75)	**1.96 (1.36, 2.81)**	**1.47 (1.10, 1.97)**	**1.36 (1.20, 1.53)**	**1.19 (1.05, 1.36)**	**2.00 (1.54, 2.59)**	**1.39 (1.11, 1.74)**
Between 26 and 45	0.85 (0.71, 1.03)	0.94 (0.78, 1.12)	0.91 (0.75, 1.12)	0.98 (0.82, 1.18)	0.97 (0.90, 1.04)	0.97 (0.90, 1.04)	0.98 (0.84, 1.15)	0.99 (0.86, 1.14)
Education level (Ref Low)								
Medium	**0.51 (0.31, 0.82)**	1.27 (0.80, 2.01)	0.70 (0.43, 1.15)	1.60 (0.99, 2.57)	**0.74 (0.61, 0.90)**	0.92 (0.76, 1.12)	**0.48 (0.33, 0.70)**	0.84 (0.58, 1.21)
High	**0.16 (0.09, 0.28)**	0.74 (0.42, 1.29)	**0.11 (0.06, 0.19)**	**0.36 (0.20, 0.70)**	**0.51 (0.42, 0.64)**	**0.73 (0.58, 0.93)**	**0.11 (0.07, 0.17)**	**0.25 (0.15, 0.42)**
Dental characteristics								
Plaque group (Ref Good)								
Moderate	**1.99 (1.23, 3.23)**	1.23 (0.81, 1.95)	**2.01 (1.19, 3.40)**	1.39 (0.83, 2.32)	**1.36 (1.12, 1.64)**	1.20 (0.99, 1.45)	**2.60 (1.70, 3.98)**	**2.00 (1.36, 3.02)**
Poor	**4.83 (2.52, 9.29)**	1.75 (0.96, 3.21)	**4.62 (2.34, 9.14)**	**2.15 (1.12, 4.13)**	**2.14 (1.66, 2.75)**	**1.55 (1.18, 2.04)**	**7.66 (4.50, 13.03)**	**3.25 (1.93, 5.47)**
Routine dental attender (Ref Never)								
Sometimes	**0.44 (0.28, 0.69)**	0.84 (0.55, 1.30)	**0.22 (0.14, 0.35)**	**0.33 (0.21, 0.53)**	**0.76 (0.64, 0.91)**	0.88 (0.73, 1.07)	**0.46 (0.32, 0.66)**	**0.64 (0.45, 0.92)**
Usually	**0.16 (0.09, 0.28)**	**0.43 (0.24, 0.75)**	**0.10 (0.06, 0.19)**	**0.13 (0.07, 0.25)**	**0.58 (0.46, 0.72)**	0.80 (0.63, 1.01)	**0.11 (0.06, 0.18)**	**0.20 (0.11, 0.34)**
Smoking								
Cumulative pack yrs	**1.08 (1.06, 1.10)**	**1.06 (1.04, 1.08)**						
Log likelihood	−822.88		−633.28		−1788.74		−674.40	

Note: Bold denotes statistical significance, $p < 0.05$.

Abbreviations: AL, attachment loss; DMFS, decayed, missing, filled tooth surfaces; IRR, incidence rate ratio.

[a] Periodontal AL $N = 419$.

[b] This is interpreted as the estimated rate ratio for one unit increase of the predictor variable while holding all other variables in the model constant.

(IRR 1.24, 95% CI 1.10–1.41), and missing teeth (IRR 1.56, 95% CI 1.22–2.00). Similarly, among males, fathering children by age 26 was positively associated with the count of tooth surfaces with untreated decay (IRR 1.47, 95% CI 1.10–1.97), DMFS (IRR 1.19, 95% CI 1.05–1.36), and missing teeth (IRR 1.39, 95% CI 1.11–1.74). No association held for number of children had and periodontal AL. By age 45, there was no association between the number of children had and accumulated dental disease experience for either men or women.

Discussion

This study found that the number of children had was not associated with periodontal AL, but was associated with untreated caries, DMFS score and tooth loss. Although, the timing of entering parenthood influenced the observed associations, with those who had children at a younger age having poorer dental health by age 45 than those who started later. There are intertwined social factors influencing a women's reproductive patterns that also influence behaviors related to the development and progression of dental caries and risk of tooth loss.

Several studies have observed an association between parity and tooth loss [4,6–8]. Three of those studies included older women (over 70 years), with a high proportion of women who were edentulous; this is likely to reflect differences in the dental treatment philosophy and social norms of that time [4,6–8]. In this study, parity was associated with tooth loss, but an association was evident only by parity at age 26 and not by parity at age 45.

The few previous studies to investigate the putative association between parity and dental caries experience have not found one [4,9,10,26]. Data from the third US National Health and Nutrition Examination Survey [7] showed partial agreement with this study. In that study, there was no association between parity and total caries (decayed and filled surfaces), but an association was observed between parity and untreated caries. The current study is the only one to observe an association between parity and total caries experience (DMFS). Since that association was no longer observable by age 45—and an association was also present among males for having children by age 26 and DMFS by age 45—it is unlikely that the parity-DMFS association was due to biological and/or behavioral changes occurring during pregnancy. Rather, characteristics associated with having children later in life (e.g., delayed childbearing to enable a person to become established in a career) may be associated with a lower experience of dental caries.

The study findings do not support the hypothesis that parity is associated with a higher experience of dental disease (periodontal AL, and caries experience). However, there was a consistent association between AL and sociobehavioral factors (smoking, lack of regular dental attendance, and poor plaque control). This suggests that those factors are more important to long-term periodontal AL than any transient effects of pregnancy and parity. Despite the well-known pregnancy-related periodontal changes (such as greater gingival inflammation) and a common perception that having children negatively affects periodontal health, only one previous study has specifically tested this hypothesis [10]. In contrast to our findings, that Tanzanian study did observe an association between parity and periodontal AL, after controlling for current age, age at first birth, family income and money spent on food. However, education and urban living were not included in the model, despite being known risk markers for periodontal disease and higher parity in Tanzania [27,28]. The generalizability of the findings from that study is limited, because those women had a much higher fertility rate and very limited access to oral health services than the current study cohort; moreover, it used a cross-sectional design.

For each child had by age 26, the risk of decayed tooth surfaces, DMFS, and tooth loss by age 45 was greater among women than men. This may be due to males' reproductive patterns being less influenced by educational attainment than for females [16]. It is also plausible that pregnancy and parity affect dental service utilization and treatment decisions that could lead to poorer long-term oral health for females.

Pregnancy and motherhood may be a perceived barrier to dental attendance for some women, especially those who believe dental treatment during pregnancy to be unsafe [29] or feel that they do not need it [1,30]. Many pregnant women will not seek dental treatment, even when experiencing dental and/or periodontal problems [31]. It is important to raise awareness that receiving dental treatment during pregnancy is safe, and that periodontal treatment at this time is effective at improving periodontal health [32].

While social disparities in dental disease experience exist, they may largely reflect social disparities in the management of dental disease [33]. This could be due to two possibilities. First, individuals may seek out different treatment options based on their health beliefs, and the value they place on an intact dentition [34]. This decision may also be influenced by financial and time constraints encountered in the early years of raising children. Second, dentists may make assumptions about the treatment needs and wants of patients. They may offer different treatment options for people of low SEP or high parity, or alter treatment plans for pregnant women, or delay treatment until after parturition [35], by which time delayed access to dental care may lead to the loss of one or more teeth.

A notable finding from this study was that women who had had children by age 26 experienced poorer dental health (in terms of untreated tooth surfaces, DMFS, and tooth loss) by age 45 than nulliparous women or women who had had children later in life. Educational aspirations have a strong bearing on when a woman will enter motherhood. Low educational attainment is also strongly associated with the risk factors for oral disease and tooth loss, such as poor oral hygiene, cariogenic diet, and episodic dental attendance [36]. The relationship between level of education, health beliefs, and health-related behaviors is complex. Cognitive function (intelligence) may predict healthy behaviors and influence entry into healthy environments (occupation, peer groups, and social milieu where high self-care is the norm), or those with lower cognitive ability may not comprehend or process health-educational messages, or face barriers to accessing health care [37]. The social factors (including cognitive ability, IQ, and educational aspirations) that influence a woman's reproductive patterns may be concordant with her health beliefs and behaviors, thereby affecting her risk for dental caries and tooth loss.

A strength of this study was the longitudinal design and high retention rate. These features have enabled the collection of extensive and robust data that provide a representative sample of its source population (the South Island of New Zealand) and provide better estimates of lifetime exposures than can be attained from a cross-sectional study design. The Dunedin study members aged matched to their peers in nationally representative surveys has shown that the findings from the Dunedin study are likely to be generalizable to the broader New Zealand population [38]. Considering the limitations, dental caries and periodontal AL may have been underestimated as the teeth were not cleaned or dried prior to examination and radiographs were not taken; moreover, periodontal measurements were taken from three sites per all teeth present, rather than six. Not all sociobehavioral data were available for all participants who were dentally examined, which excluded them from analysis. Although in the caries and tooth loss analysis, the SEP of the excluded participants did not significantly vary from those included.

Future research should consider the timing of childbearing during the lifecourse when investigating the possible association between parity and oral health. Pregnant women (particularly younger ones) should be a key target group for improved access to primary dental care.

Conclusion

Our findings suggest that sociobehavioral factors (poor oral hygiene, irregular dental attendance, and smoking) are more important to the development of dental and periodontal disease than any biological effects of having children. The social factors associated with having children earlier in life appeared to be important influences on adverse health beliefs and behaviors which, in turn, may increase the risk of dental disease and how it is managed.

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