

An Assessment of the Association Between Functional Edentulism, Obesity, and NIDDM

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OBJECTIVE — To assess the association between a measure of extensive tooth loss (functional edentulism) and obesity with non-insulin-dependent diabetes mellitus (NIDDM) in a racially heterogeneous sample.

RESEARCH DESIGN AND METHODS — A cross-sectional survey (370 subjects) was performed by reviewing the medical and dental records of dependently or independently living individuals who were treated as inpatients and/or outpatients at a Department of Veterans Affairs facility. Frequencies and descriptive measures were derived; univariate and multiple logistic regression analyses were conducted to test for associations, confounding, effect modification, and interaction using functional edentulism and obesity as the independent variables and NIDDM as the dependent measure.

RESULTS — Functionally edentulous individuals were at significantly greater risk for NIDDM (estimated odds ratio [OR] = 4.06), than the obese (OR = 3.29). These relationships were not confounded by age or race in this sample. Obesity did confound functional edentulism in the multivariable model, suggesting that they act independently on the outcome variable (NIDDM).

CONCLUSIONS — Dentist-assessed functional edentulism and physician-diagnosed obesity were significantly associated with NIDDM in this sample of predominantly older men. This finding ought to be considered by primary care providers in formulating dietary strategies in order to facilitate the realization of their therapeutic goals.

Recent studies suggest an increase in tooth loss in diabetic individuals (1) and in the prevalence of complete edentulousness among non-insulin-dependent diabetes mellitus (NIDDM) patients who are members of special pop-

ulations (2). Secondary data analysis has identified a significantly increased risk of NIDDM among unrestored edentulous Hispanic individuals (3). Of related concern, diminished dental capacity has been associated with reduced functional efficiency and concomitant dietary selectivity (4–6). Trends have shown that completely edentulous persons tend to avoid protein, fiber, fresh fruits, and vegetables in favor of softer foods rich in carbohydrates and saturated fats (7); this invites the risk of obesity. The association between obesity and NIDDM is well established (8); that between extensive tooth loss and NIDDM is not. Our specific interest is to assess the association between extensive tooth loss and obesity and NIDDM in a sample of people who do not bear the characteristics of special populations with well established risks (i.e., Pima Indians or Hispanic Health and Nutrition Examination Survey [HHANES]).

This study was based upon the assumption that an association exists between extensive tooth loss and NIDDM and upon the assumption that obesity might influence this outcome. We hypothesize that a significant association exists between NIDDM, obesity, and a measure of extensive tooth loss (functional edentulism).

RESEARCH DESIGN AND METHODS

To test this hypothesis, a cross-sectional survey of a randomly selected sample ($n = 370$) of patient records was conducted at a Department of Veterans Affairs facility. The surveyed records were of patients living dependently or independently in the hospital or community. Data were abstracted concerning age, race, sex, physician-diagnosed NIDDM and obesity, and dentist-assessed dental status. Criteria for the diagnosis of NIDDM were those of the National Diabetes Data Group (9); obesity was defined as a body mass in excess of 25% over the ideal body mass. For purposes of the study, dental status was categorized into one of three groups: dentate

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CI, confidence interval; NIDDM, non-insulin-dependent diabetes mellitus; OR, odds ratio.

Table 1—Univariate analyses of maximum likelihood estimate

Independent variable	Parameter estimate	Standard error	Chi-square	P value	OR	95% CI
Age	0.0473	0.0162	8.5397	0.0035	1.05	1.02–1.08
Race	−0.9121	1.0448	0.7621	0.3827	0.40	0.05–3.11
Obesity	1.2951	0.6333	5.8969	0.0152	3.65	1.28–10.39
Functional edentulism	1.8914	0.5286	12.8026	0.0003	6.63	2.35–18.68

Results of univariate analyses (4) of age, race, obesity, and functional edentulism versus NIDDM (dependent variable). $n = 292$.

(26 or more teeth), partially edentulous (7–25 teeth), or functionally edentulous (6 or fewer teeth). After removing all records with missing data values, 292 cases were analyzed (SAS) (10,11). Distributions of variables were followed by univariate analyses. A logistic regression model was used to correct for confounding and to detect significance of main and interactive effects. Alternative models were constructed to rule out multicollinearity, and regression diagnostics were performed to assess and improve fit.

RESULTS— The sample was 96.2% men and 3.8% women and had a mean age of 47.5 years with a standard deviation of 13.1 years and an age range of 27–86 years. Distribution by race was 47.6% Caucasian, 40.1% black, and 12.3% Hispanic. The prevalence of physician-diagnosed NIDDM was low (6.2%), and a physician diagnosed 13.4% of the sample as obese. Dental status was distributed as follows: dentate, 24.0%; partially edentulous, 65.4%; and functionally edentulous, 10.6%.

The age effect was significant in the univariate model (Table 1), suggesting the expected relationship between increasing age and NIDDM ($P = 0.0035$). However, after considering confounding and interaction with the multivariable model, age was no longer associated with NIDDM in this sample. This may be attributable to ~70% of the sample's ages falling between 34 and 61 years. Likewise, no significance was detected for either the sample's race or its sex effects.

The dental effect defined the den-

tate and partially edentulous groups with similar NIDDM rates (4.29% and 4.19%); however, the functionally edentulous group had a dramatic increase in NIDDM with a rate of 22.5% (Fig. 1). Comparing the functionally edentulous group with the others resulted in an odds ratio (OR) estimate of 6.63, 95% confidence interval (CI) 2.35–18.68, which decreased slightly after adjusting for small sample bias ($\hat{OR}_{ss} = 5.83$, 95% CI 2.45–18.10). The OR decreased further ($\hat{OR} = 3.29$, 95% CI 1.15–9.41) when confounding was considered (Table 2). Such a dramatic change in likelihood between the univariate and multivariable models was seen only for the variables of functional edentulism and obesity.

Physician-diagnosed obesity was significantly associated with NIDDM, as

expected. The univariate model (Table 1) revealed that subjects who had been diagnosed as obese were 3.5 times more likely to be positive for NIDDM than nonobese subjects. Adjustment for confounding (Table 2) decreased this estimate only slightly ($\hat{OR} = 3.29$); this was consistent with a population effect as low as 1.15 and as high as 9.41.

The multiple logistic regression model adjusted for confounding and revealed that obesity and functional edentulism were significantly associated with NIDDM ($P = 0.03$ and 0.02 , respectively). The association of NIDDM with these two variables ($\hat{OR} = 3.29$ and 4.06) was large. The confidence intervals were wide, indicating that sample size was small and/or variability high. Confounding did occur in the multivariable model

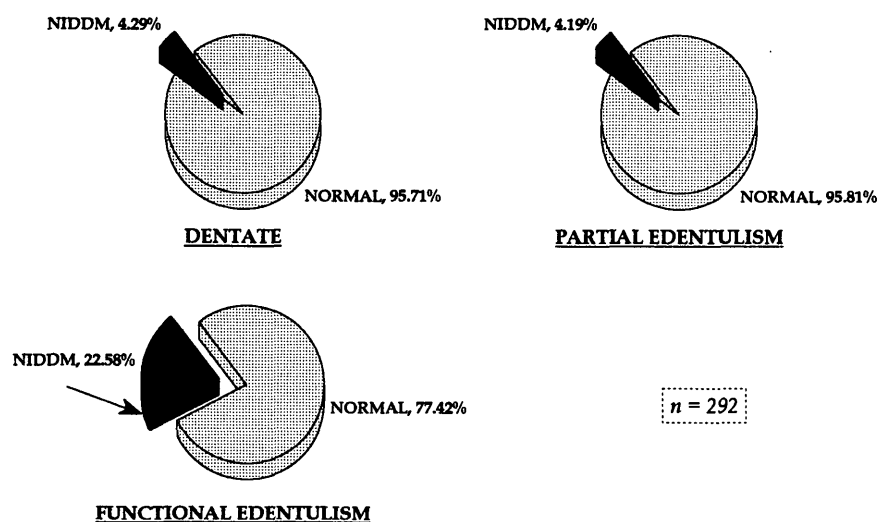


Figure 1—The prevalence of NIDDM is significantly higher for the functionally edentulous group.

Table 2—Analysis of maximum likelihood estimate

Independent variable	Parameter estimate	Standard error	Chi-square	P value	OR	95% CI
Intercept	-4.7786	1.0283	21.5954	0.0001	0.01	0.00–0.06
Age	0.0308	0.0190	2.6210	0.1055	1.03	1.00–1.07
Race	-0.8647	1.0633	0.6614	0.4161	0.42	0.06–3.05
Obesity	1.1913	0.5646	4.4514	0.0349	3.29	1.15–9.41
Functional edentulism	1.4018	0.6049	5.3707	0.0205	4.06	1.32–12.52

Results of multiple logistic regression analysis of association of age, race, obesity, and functional edentulism with NIDDM (dependent variable).

between functional edentulism and obesity, suggesting that they act independently on the outcome variable (NIDDM). None of the possible two-way interactions were significant ($P < 0.05$).

CONCLUSIONS— We conclude that, for a sample of predominantly older men, functional edentulism and obesity are significantly associated with NIDDM ($P = 0.0205$, $P = 0.0349$). Obesity appears to confound the relationship between functional edentulism and NIDDM, and this should be explored.

It is beyond the scope of this study to assess the effect of dental restorative status or the duration of NIDDM on the association described here. This is recommended as a focus for future efforts.

Little concern has been focused upon the functional dental capacity of diabetic individuals. Significant functional impairment is the direct result of extensive tooth loss. Functional edentulism is a fundamental representation of this gross depletion of oral functional capacity. This has important therapeutic implications. It is presumptuous to expect good dietary compliance from patients with compro-

mised masticatory function. Therefore, medical care providers and nutritional therapists need to be aware of this limitation and alter therapeutic strategies in a way that is designed to address this risk and to resolve or accommodate it in order to enhance dietary control and realize treatment goals.

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