

# The dietary adequacy of edentulous older adults

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**This study tested the null hypothesis that there are no differences in dietary patterns or adequacy between edentulous patients and individuals with nearly complete dentitions. The research design involved comparing the dietary patterns and adequacies of 34 edentulous subjects who regularly wear dentures with 38 subjects who had nearly complete dentitions. The subjects were between the ages of 51 and 83 years and were sampled from patients attending Case Western Reserve University Dental Clinic. Although edentulous subjects were more likely to claim that they had trouble chewing their food, they were not more likely to select easy-to-chew foods. On the other hand, the diet of dentate subjects tended to be superior to that of edentulous subjects, as indicated by a lower fat and cholesterol consumption and a higher consumption of protein and all of the vitamins and minerals (significantly or nearly significantly for vitamin A, ascorbic acid, calcium, and riboflavin). (J PROSTHET DENT 1995;73:142-5.)**

Extensive tooth loss tends to be associated with aging. For example, 19.0% of 55- to 64-year-old U.S. adults were edentulous in 1989 and this figure rose to 40.7% of individuals 75 years of age and older.<sup>1</sup> One reason this pattern is pertinent is that tooth loss, even with denture replacement, tends to result in a reduced masticatory functional capacity.<sup>2-8</sup> Numerous experts in both dentistry and nutrition have asserted that this reduced masticatory functional capacity results in a significant alteration of dietary patterns, with the edentulous patients consuming fewer tough but nutritious foods, such as meat, fruits, and raw vegetables, and instead increasing their consumption of softer foods such as processed foods, refined carbohydrates, and soft drinks.<sup>9-19</sup> Given that the latter group of foods tends to have a low content of many essential nutrients and a high content of salt, sugar, cholesterol, and fat, such a dietary change should result in a decrease in dietary adequacy, which would in turn potentially lead to a further deterioration of oral health and increase the risk for various chronic diseases.<sup>13, 17, 20, 21</sup>

Surprisingly, although the effect of tooth loss and denture wearing on masticatory functional capacity has been intensively studied, relatively few studies have examined the impact of deteriorating oral health on food selection and ultimately on dietary adequacy. The few studies that have been conducted suggest that tooth loss, with and without denture wearing, is often associated with an

increased consumption of soft foods but this does not necessarily result in a decrease in dietary adequacy.<sup>8, 12, 17, 22</sup>

This study provides an additional test of the null hypothesis that there are no differences in dietary patterns or dietary adequacy between edentulous patients and individuals with nearly complete dentition.

## SAMPLE AND METHODS

The population sample was collected from patients attending the general (N 60) and prosthetic clinics (N 51) of the Case Western Reserve University Dental School in Cleveland, Ohio. The expectation was that subjects with full or nearly full dentitions would be drawn from the general clinic, and denture wearers who had lost most or all of their teeth would be recruited at the prosthetics clinic. However, there was considerable variability with respect to the amount of tooth loss in the subjects obtained from both sources. In particular, there were relatively few older individuals who attended the general clinic and had complete dentitions. Therefore, to maximize the differences between samples in dentition status and to ensure adequate sample sizes, the following two subsamples were created: (1) subjects with no natural teeth who reported regularly wearing dentures (referred to as the edentulous sample) and (2) subjects with at least 24 teeth who did not wear dentures (referred to as the dentate sample). The ideal comparison sample would have included individuals with complete dentitions or at least individuals who had not lost any molars but this was not feasible. If the results claimed by scientific investigators that any tooth loss, with or without denture replacement, results in a reduction of masticatory function are true,<sup>2, 4-6, 23, 24</sup> then this in turn should lead to an increased consumption of soft foods with a low nutrient content, which should be reflected by differing dietary patterns and dietary adequacies in the two samples.

The final sample consisted of 34 edentulous subjects (16

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men, 18 women; 14 African-American, 20 white) and 38 dentate subjects (15 men, 23 women; 15 African-American, 23 white). The age range of the sample was 51 to 83 years (mean  $\pm$  SD 66.9  $\pm$  8.5 years). There were no significant differences between samples in mean age, height, or weight or in the distribution of sex, ethnicity, marital status, occupation, or education level ( $p > 0.05$ ). However, there were significant differences between samples in self-reported annual income. In particular, 78.1% of the edentulous sample but only 48.4% of the dentate sample had incomes of less than \$15,000 ( $\chi^2$  6.0;  $p < 0.05$ ).

Twenty-four hour dietary recalls and a questionnaire that covered various food-related behaviors were administered by upper level undergraduate students in the human nutrition program. The data on food consumption were converted to the nutrient content of the diet,<sup>25, 26</sup> and the percent of the recommended dietary intake (%RDA), as a measure of dietary adequacy, was calculated for each nutrient.<sup>27</sup> The limitations of a single 24-hour dietary recall have been identified by Madden et al.<sup>28</sup> Nevertheless, 24-hour dietary recalls in an autonomous elderly population have proved to be useful in other investigations.<sup>29</sup>

## RESULTS

The results of analyses of covariance (ANCOVA) of the %RDAs between edentulous and dentate subjects, after controlling for age, are presented in Table I. Daily dietary energy intake was low in both samples, only approximately 67% of the RDA, but significant differences were not observed ( $p > 0.05$ ). Protein and fat %RDAs were above 100% in both samples and the cholesterol %RDAs were below 100% in both samples, but in each case there were no significant differences between samples ( $p > 0.05$ ). Finally, the %RDAs for the vitamins and minerals tended to be higher in the dentate than in the edentulous sample, with the %RDAs for vitamin A and ascorbic acid significantly higher in the dentate sample ( $p < 0.05$ ) and those for calcium and riboflavin approaching significance ( $p < 0.10$ ). However, with the exception of the %RDA for calcium in both samples and the %RDA for vitamin A for the edentulous sample, all of the mean vitamin and mineral %RDAs were above 100%.

The three nutrients that exhibited the greatest differences in dietary adequacy between samples were calcium, vitamin A, and ascorbic acid. To determine the different patterns of food consumption that led to the differences between samples in these nutrients, the individual dietary records of the subjects were examined. The higher intake of calcium by the dentate subjects was primarily because twice as many dentate as edentulous subjects consumed milk. The higher intake of vitamin A in the dentate subjects was primarily because they were approximately twice as likely as the edentulous subjects to consume milk and vitamin A rich vegetables (broccoli, green pepper, carrots). Finally, the higher intake of ascorbic acid in the dentate sample was primarily because approximately twice as

**Table I.** Percent of RDA in the edentulous (N 34) and dentate (N 38) samples

	Age-adjusted mean %RDA		
	Edentulous	Dentate	F
Energy (MJ)	66.7	67.2	0.0
Protein (gm)	103.3	110.8	0.4
Fat (gm)	124.1	122.0	0.1
Cholesterol (mg)	80.5	70.8	0.4
Calcium (mg)	57.8	77.3	3.5
Iron (mg)	106.0	125.2	2.6
Vitamin A (RE)	66.4	129.1	7.4*
Thiamine (mg)	108.4	111.7	0.1
Riboflavin (mg)	102.1	127.4	2.9
Niacin (mg)	116.0	132.8	1.5
Ascorbic Acid (mg)	106.9	177.5	6.5*

\* $p < 0.05$ .

many dentate as edentulous subjects consumed fruits (orange juice) and vegetables (tomatoes, green peppers) with a high content of ascorbic acid.

Dietary diversity was assessed on the basis of the total number of different food items consumed. The edentulous sample consumed a median of 11 items and the dentate subjects consumed a median of 13 different items of food. A median test indicated that these values were not significantly different ( $\chi^2$  0.3,  $p > 0.05$ ). In addition, a median test indicated that the consumption of foods that tend to be harder to chew (legumes, nuts and seeds, meat, vegetables) also did not differ significantly between samples ( $\chi^2$  0.0,  $p > 0.05$ ), with each group consuming a median of three items of food from these food groups.

Because the dentate sample reported a significantly higher income than the edentulous sample and because income has such a strong influence on dietary patterns,<sup>30, 31</sup> additional analyses were performed on a subset of the sample that included only those individuals with incomes of less than \$15,000 (25 edentulous, 15 dentate). The results of these analyses were similar to those for the entire sample. In particular, the median number of total different foods consumed within each dental category in this subsample and the number of foods within the three categories with harder-to-chew foods were identical to those for the total sample. The %RDAs in those with incomes of less than \$15,000 were also similar to those for the total sample with one exception. When only individuals with incomes of less than \$15,000 were considered, the %RDA of ascorbic acid did not differ significantly between groups ( $p > 0.05$ ).

Finally, edentulous subjects were significantly less likely than dentate subjects to take vitamin or mineral supplements and were significantly more likely to report that they had trouble chewing food (Table II,  $p < 0.01$ ). However, there were no significant differences between samples with respect to other food-related behaviors, although the

**Table II.** Food-related behaviors in the edentulous (N 34) and dentate (N 38) samples

	Edentulous		Dentate		$\chi^2$
	N	%	N	%	
Involved in food purchasing	27	79.4	30	78.9	0.0
Income affects food purchasing	12	35.3	6	15.8	3.6
Involved in food preparation	23	67.6	31	81.6	1.9
On a diet	11	32.4	18	47.4	1.7
Regularly eat at restaurants	17	50.0	20	52.6	0.0
Regularly eat at fast-food restaurants <sup>a</sup>	11	36.7	7	18.9	2.7
Take vitamin or mineral supplements <sup>b</sup>	7	20.6	20	54.1	8.4*
Have trouble chewing food	16	47.1	7	18.4	6.8*

<sup>a</sup>N 67 Responses to question; 30 edentulous and 37 dentate.

<sup>b</sup>N 71 Total taking vitamin or mineral supplement; 34 edentulous and 37 dentate responded.

\* $p < 0.01$ .

statement that income affects food purchasing approached significance (Table II,  $p < 0.06$ ).

## DISCUSSION

Aging in the United States does not appear to be associated with marked dietary deficiencies, but large numbers of the U.S. elderly nevertheless tend to have low intakes of some nutrients.<sup>32,33</sup> The primary factor to determine whether the elderly are in the well-nourished or poorly nourished group is income,<sup>30,31</sup> but a change in dietary patterns as a result of tooth loss and denture wearing has been hypothesized to play an important secondary role in influencing the nutritional status of the elderly.<sup>2-17,19</sup> The goal of this report was to evaluate the null hypothesis that there are no differences in dietary patterns or dietary adequacy between edentulous subjects and individuals with nearly complete dentition.

The nutrient intakes and dietary adequacies of the subjects in this study, particularly the dentate subjects, are similar to those reported for other studies of the elderly.<sup>31</sup> The mean % RDA for energy was only approximately 67% in both samples and suggests that the subjects underreported their food intake. However, because the % RDA for energy did not differ significantly between samples ( $p > 0.05$ , Table I), it can be concluded that energy intake was underreported equally in both groups and that, as a result, this should not influence comparisons of dietary adequacy between samples.

The first component of the hypothesis tested in this study—that tooth loss and denture wearing result in a modification of dietary patterns and, in particular, in an increased consumption of easy-to-chew foods<sup>8,12,17,22</sup>—was not supported by the results of this study. In particular, the dentate subjects did have a somewhat more diverse diet than the edentulous subjects, but there were nevertheless no significant differences between samples in either overall dietary diversity or in the frequency of consumption of foods that are hard to chew. Of the three nutrients that tended to be underconsumed by the most subjects (calci-

um, vitamin A, and ascorbic acid), only the difference for ascorbic acid was primarily the result of differences in frequency of the consumption of foods that, when raw, can be hard to chew (broccoli, green peppers, carrots).

Finding no differences between edentulous and dentate subjects in dietary patterns would appear to be inconsistent with the finding that edentulous subjects were approximately 2.5 times as likely as dentate subjects to state that they had trouble chewing food ( $p < 0.05$ ), and approximately 47% of the edentulous subjects made this complaint (Table II). Possible explanations for this apparent contradiction are that the edentulous subjects simply did not allow discomfort to affect their eating habits<sup>16</sup> or that the dietary differences between groups are more subtle than can be detected by comparing food groups between subject samples.<sup>19</sup>

Although the results of this study suggest that tooth loss does not result in a modification of eating habits, they do indicate that tooth loss and denture wearing is associated with a decrease in dietary adequacy. In particular, the diet of the dentate subjects tended to be superior to that of the edentulous subjects (Table I), as indicated by lower fat and cholesterol % RDAs and by higher % RDAs for protein and all of the vitamins and minerals (significantly or nearly significantly for vitamin A, ascorbic acid, calcium, and riboflavin). It is pertinent that these differences exist even though individuals who had lost some of their teeth were included in the dentate sample. In other words, the differences between samples in dietary adequacy may have been even greater if the dentate sample included only individuals with complete dentitions. Thus, contrary to the findings of previous studies,<sup>8,11,17,22</sup> the results of this study indicate that tooth loss and denture wearing are not associated with a change in dietary patterns but are associated with a decrease in dietary adequacy.

## CLINICAL IMPLICATIONS

The finding that tooth loss and denture wearing, both of which affect many Americans as they age,<sup>1</sup> are associated

with a decrease in dietary adequacy has several implications for practicing dentists. First, this finding can be used in office education programs designed to encourage patients to maintain their teeth throughout life. Second, once tooth loss and denture replacement has occurred, these data suggest that patients should be directed to a registered dietician who can assist them in monitoring their diets more closely to ensure that a decrease in dietary adequacy, and ultimately decreases in both overall and dental health,<sup>13, 17, 20, 21</sup> do not occur.

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