

**ORAL HEALTH AND NUTRITIONAL INTAKE
IN ONTARIO ADULTS AGED 65 YEARS AND OLDER**

Yasmin Miller and David Locker

COMMUNITY DENTAL HEALTH SERVICES RESEARCH UNIT

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SUMMARY

A preliminary investigation of the relationship between oral health status and nutritional intake in Ontario adults aged 65 years and older was undertaken using data from the nutrition and dental health sections of the Ontario Health Survey 1990. The nutrition section of the OHS consisted of a self-administered food frequency questionnaire which collected information concerning the frequency and quantity consumed of over 80 food items. The data were used to compute basic nutrition variables encompassing energy consumption (kcal), number and type of food servings and the intake of several vitamins and minerals. The dental health section of the OHS contained questions pertaining to dental status and oral impairment.

This study compared the mean daily intake of twelve nutrition variables according to three oral health variables: dental status, chewing ability and the presence or absence of oral symptoms. Comparisons were made for the population as a whole as well as by calorie quartiles.

The results indicated that the oral health factors used in these analyses were not related to any deficiencies in the nutrients studied. However, some differences were observed between the oral health groups. There was a trend for edentulous individuals, those with problems chewing and those experiencing oral symptoms to report a slightly lower intake of fruits and vegetables, fibre, vitamin C, calcium and riboflavin. Although Recommended Nutrient Intakes were met by almost all study groups, 40% of all older adults reported a daily intake of calories below the RNI of 1800 kcal/day.

This report suggests that the trends revealed in this study warrant further investigation. Future studies should take into consideration socioeconomic and health variables as well as more comprehensive measures of oral health.

INTRODUCTION

Proper nutrition is vital for sustaining overall physical and psychological well-being. Nutritional deficiencies can impede basic metabolic processes, exacerbate existing ailments, diminish immune responses and ultimately lead to disease. A sufficient nutritional intake is especially important for preserving optimum immunity in older adults because both aging and nutritional deficiencies are associated with impaired immune responses (Chandra, 1989). Eating a balanced diet is the primary means of acquiring essential nutrients. Poor oral health may interfere with the ability to maintain an optimal diet and consequently place an individual at higher risk for developing nutritional deficiencies and illness.

The elderly are particularly vulnerable to a compromised nutritional status as well as to oral health problems, due to physiological changes associated with aging, chronic diseases and use of medications. A study of non-institutionalized elderly subjects in Newfoundland found a high proportion were deficient in several nutrients (Chandra, 1989). For example, 18% did not meet the recommended energy intake, 12% consumed an insufficient amount of protein and over one fifth had inadequate dietary levels of iron, zinc and vitamin C. Another study investigating nutritional intake in older adults with xerostomia (dry mouth), found that 25% of free-living seniors with xerostomia had an inadequate intake of all 12 nutrients analyzed (Rhodus & Brown, 1990). From 50% to 100% of these subjects did not meet recommended dietary allowances for several of the nutrition variables. Such deficiencies were even more pronounced in the institutionalized subjects. The control group which consisted of older adults without xerostomia also had insufficient intakes of several essential nutrients.

Among the elderly there is also a greater prevalence of periodontal disease and tooth loss which can restrict the capacity to chew food. Recent studies conducted in Metro Toronto found that 18% of subjects aged 65 years and older had experienced the loss of one or more teeth within the previous year (Miller & Locker, 1994) and 33% reported limitations in their ability to chew (Locker & Miller, 1994). Masticatory

ability is increasingly reduced the more the natural dentition is compromised (Carlsson, 1984; Wayler et al, 1984). Food items requiring more thorough mastication such as apples, pears and fresh vegetables are more likely to be consumed by subjects with a greater number of remaining natural teeth (Halling et al, 1988). Subjects who report having difficulty chewing have been shown to consume fewer calories (Gordon et al, 1985) and report less frequent use of hard foods such as raw fruits and vegetables (Rusen et al, 1993).

In comparison to dentate adults, individuals with full dentures have a considerably lower bite force (Heath, 1982) and require a greater number of chewing strokes to reduce food to a swallowable point (Wayler et al, 1984). The degree to which the wearing of dentures influences nutrition is somewhat equivocal. Some studies have reported no significant differences in the dietary intake of subjects with varied dentitions (Baxter, 1984; Gunne & Wall, 1985; Gordon et al, 1985) while others have found that compared to dentate subjects, those with dentures consumed significantly fewer nutrients (Papas et al, 1989; Halling et al, 1988; Osterberg & Steen, 1982).

Although it has been demonstrated that older adults may have an increased susceptibility towards poorer oral health which in turn may compromise nutritional status, the extent of this relationship is not entirely clear. In an effort to gain a better understanding of this association, data from the Ontario Health Survey were used to undertake a preliminary investigation of oral health and its relation to nutritional intake in adults aged 65 years and older.

METHODS

The Ontario Health Survey

The 1990 Ontario Health Survey (OHS) was developed as a collaborative project by the Ministry of Health and the Premier's Council on Health, Well-Being and Social Justice. The purpose of the OHS was to collect data concerning the health status of the population of Ontario. The survey was organized into 13 sections encompassing a wide range of health-related variables. Only an overview of the OHS will be presented here as a complete description of the design and methodology is available elsewhere (Ontario Health Survey 1990: User's Guide Vol.1 Documentation, Ontario Ministry of Health, 1992).

The target population consisted of residents of private dwellings in Ontario during 1990. Using a multi-stage stratified cluster design, a sample of 35,479 households was selected from the 1986 Canada Census enumeration areas within each of the province's 42 Public Health Units. The OHS was composed of two parts: a personal interview and a self-administered questionnaire. The personal interview was conducted with a household member who could knowledgeably answer questions about each person occupying that residence. A self-complete questionnaire was provided for each resident meeting the minimum age requirement of 12 years.

The personal interviews generated a response rate of 87.5% and yielded information for 77,663 individuals. Of these, 63,663 people were eligible to complete the self-administered questionnaire. The response rate for this portion of the survey was 77.2% and supplied data for 49,164 people aged 12 years or more. These respondents resided in households with a total of 12,075 children less than 12 years of age, which produced a final data set consisting of information on 61,239 people of all ages. The sample responses were subsequently weighted in order to reflect the entire population of Ontario. When weighted, OHS data represents a provincial population of 9,743,720 of which 8,147,699 are 12 years of age or older.

The OHS involves a complex survey design and any reports releasing this data are expected to observe established criteria. All percentages and numbers must be based upon weighted data and as such represent population estimates and not sample statistics. Estimates which are derived from less than 30 survey respondents cannot be released. Weighted estimates determined from 30 or more respondents are subject to the following sampling variability guidelines: estimates with a coefficient of variation ranging from 0 to 16.5 can be released with no restrictions; those ranging from 16.6 to 25.0 must be qualified as such estimates are associated with high sampling variability; those within 25.1 to 33.3 require that the sampling variability be obtained using an exact variance calculation procedure; coefficients of variation greater than 33.4 cannot be released.

Dental Health Section

The collection of dental health data was confined to the use of self-reports and did not involve clinical examinations. Several questions pertaining to dental status, oral impairment and dental care attendance pattern comprised this segment of the self-administered portion of the OHS.

The following dental health variables were selected for this study:

- **Dental Status** - Dental status was defined as either dentate or edentulous according to the presence or absence of any natural dentition.
- **Chewing Capacity** - The chewing index used in the OHS was a shortened version of the Index of Chewing Ability (Leake, 1990). Participants were asked whether they were able to bite off and chew a piece of raw apple or carrot and whether they could ordinarily chew firm meats such as steaks or chops. Respondents were classified as having a chewing limitation if they were unable to chew one of these three food items.

- Oral Symptoms - A five-item inventory was used to assess oral symptoms. Respondents were asked if during the previous month they had experienced any of the following: toothache, tooth pain from hot, cold or sweet foods or beverages, pain in jaw joints, denture pain or discomfort or sore or bleeding gums. Responses were grouped according to whether or not adults reported experiencing one or more of these symptoms.

Nutrition Section

Nutritional intake was determined by means of a food frequency questionnaire which was included in the self-administered component of the OHS. The validity of the OHS Food Frequency Questionnaire has been established and a detailed description has been previously reported (Bright-See, 1994). In developing the questionnaire, three nutrients were established as primary health concerns: fat as percentage of energy, fibre and calcium. These nutrients formed the basis of selection when the list of foods was compiled. Included were those foods most commonly used to allow for the most comprehensive estimate of the three priority nutrients and enable other nutrients to be assessed as well.

Respondents were asked to record their dietary habits through a series of questions concerning the frequency and quantity consumed of over 80 specified food items. This information was used to derive basic nutrition variables pertaining to the number and type of food servings, the amount of energy consumed, the dietary percentage of fat, protein and carbohydrate and the intake of seven vitamins and minerals. To determine the number of food servings each food item included in the Food Frequency Questionnaire was assigned to one of the following eight food groups: breads and cereals; milk products; meat, poultry, fish, eggs, nuts and legumes; fruits and vegetables, mixed dishes (containing ingredients from more than one group); added fats; desserts and sugar; coffee and tea. All derived nutrition variables were computed based upon a mean daily intake.

The following list consists of the nutrition variables selected for this study¹ as well as the corresponding Recommended Nutrient Intake (RNI)²:

- Energy (kcal) 1800 - 2600 kcal³
- Food Servings N/A
- Carbohydrate 55% of kcal
- Fat 30% of kcal
- Protein 15% of kcal
- Fibre N/A
- Vitamin C 30 mg (females); 40 mg (males)⁴
- Iron 8 mg (females); 9 mg (males)
- Calcium 800 mg
- Niacin 14.4 - 22.0 NE⁵
- Riboflavin 1.0 - 1.6 mg⁶
- Thiamin 0.8 - 1.3 mg⁷

- 1 Vitamin A was not selected for study due to the difficulty in obtaining a valid estimate (Bright-See, 1994).
- 2 Nutrition Recommendations: The Report of the Scientific Review Committee. Health and Welfare Canada (1990).
- 3 Recommended energy requirements are dependent upon age, sex and level of activity. This range applies to adults aged 50 years or more engaging in light to moderate activity.
- 4 Smokers should increase vitamin C by 50%.
- 5 7.2 NE/1000 kcal with a minimum of 14.4 NE/day. NE equal to 1 mg of niacin or 60 mg of dietary tryptophan.
- 6 0.5 mg/1000 kcal with a minimum of 1.0 mg/day.
- 7 0.4 mg/1000 kcal with a minimum of 0.8 mg/day.

Analyses

To investigate the possible influence of caloric intake upon oral health and nutrition, the population was grouped into quartiles based upon daily calorie consumption. Comparisons of the mean daily intake of each nutrient were made within each calorie group according to the three oral health variables studied. Results are presented in the form of bar graphs. Where applicable, the recommended nutrient intake of each nutrition variable is indicated on the graph in the form of a broken horizontal line.

RESULTS

Study Population

The OHS sample generated a weighted total of 1,136,681 respondents at least 65 years of age. Of these, 315,913 (28%) did not complete the nutrition section of the survey. Daily energy consumption was computed for the remaining 820,768. To minimize bias due to over and under reporting, the distribution of caloric intake was normalized and subjects with extreme values (i.e. scores more than two standard deviations above or below the mean) were excluded from the analyses. The final data set consisted of a weighted population count of 778,318 representing all Ontarian adults aged 65 years or more. Table 1 provides a sociodemographic breakdown of the study population.

Table 1. Sociodemographic Characteristics of Population.

Sociodemographic Variables	Percentage of Population
Sex	
Male	42.8%
Female	57.2%
Household Income	
Less than \$20000	36.2%
\$20000 to \$39999	37.1%
\$40000 or more	26.7%
Level of Education	
Primary	25.9%
Some Secondary	25.9%
Completed Secondary	23.0%
Post Secondary	25.2%
Dental Insurance	
No	69.8%
Yes	30.2%

Oral Health Status

Figure 1 shows the distribution in this older adult population of the three oral health variables studied. Just over one third of the population described their dental status as edentulous. The majority of these people reported wearing dentures. Only 1.4% of the population recorded that they were edentulous and without dentures. Due to the low percentage of edentulous adults who did not wear any dentures, all edentulous people were combined for analyses conducted in this report. Problems chewing were reported by 27.4% of the population and nearly one quarter of the population indicated experiencing oral symptoms during the one-month reference period.

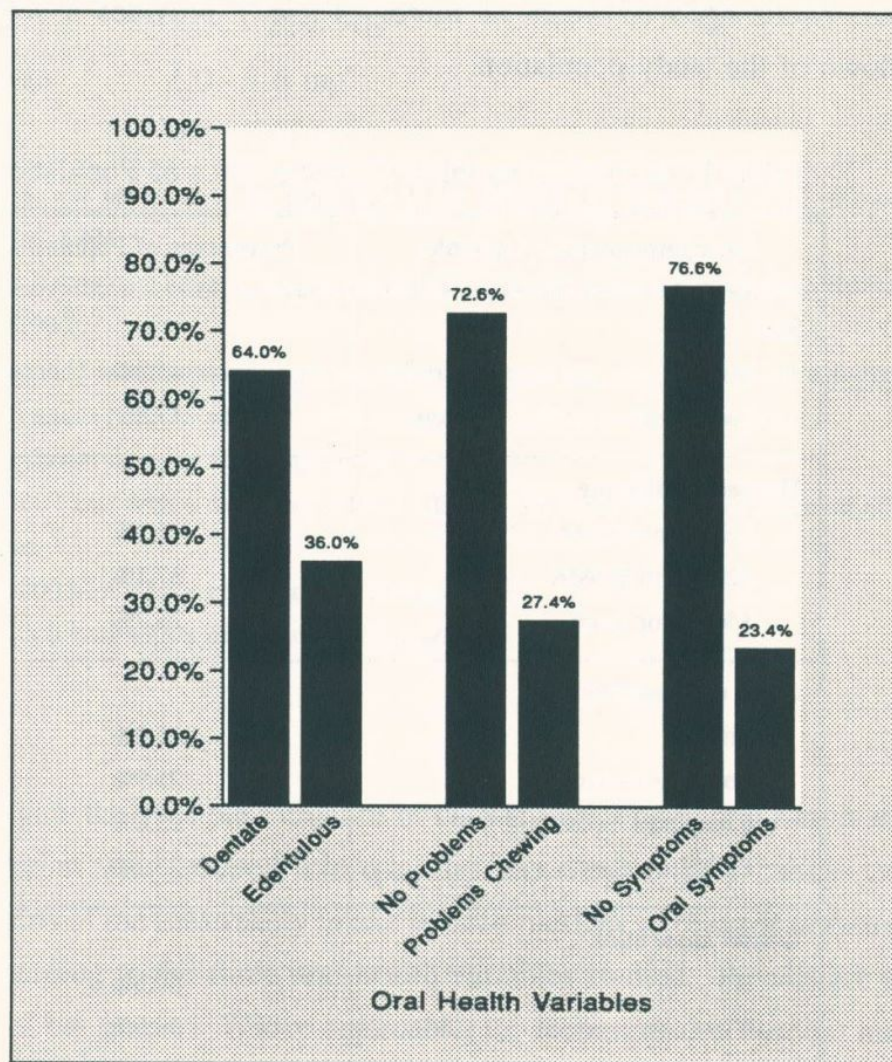


Figure 1. Population Distribution by Oral Health Variables.

Nutritional Status

1. Energy Intake

The overall mean daily energy intake from the total food and beverages consumed was 2105 kilocalories. Nearly 40% of the population reported consuming under 1800 calories per day which is less than the recommended amount. When calories were divided into quartiles, the values of the percentiles were as follows: 25th percentile: 1554.02 kcal; 50th percentile: 1985.85 kcal; 75th percentile: 2544.11 kcal. Rounding of the group values resulted in the following four calorie groups used in the analyses in this report: less than 1500 kcal/day ($\mu=1237$); 1500 to 1999 kcal/day ($\mu=1748$); 2000 to 2499 kcal/day ($\mu=2223$); and 2500 or more kcal/day ($\mu=3118$). The percentage of the population in each calorie group ranged from 22.1% to 28.7% and is shown in Figure 2a.

Figures 2b to 2d presents the population distributions in each calorie group according to the three oral health variables. Only minor differences ranging from 0.7% to 4.4% were noted in the distributions of each group. Comparisons of dentate and edentulous persons revealed little differences in the higher energy intakes groups, but did show a greater proportion of edentulous people consuming less than 1500 kcal/day and less edentulous people consuming 1500 to 1999 kcal/day. Adults with problems chewing were more likely to take in under 1500 kcal/day and less likely to consume more than 1500 kcal/day than those with no chewing limitations. There were some differences in the distributions of those with and without oral symptoms, but these were primarily reflected in the two higher calorie groups. Although less people with oral symptoms consumed 2000 to 2499 kcal/day, they were also more likely to consume over 2500 kcal/day.

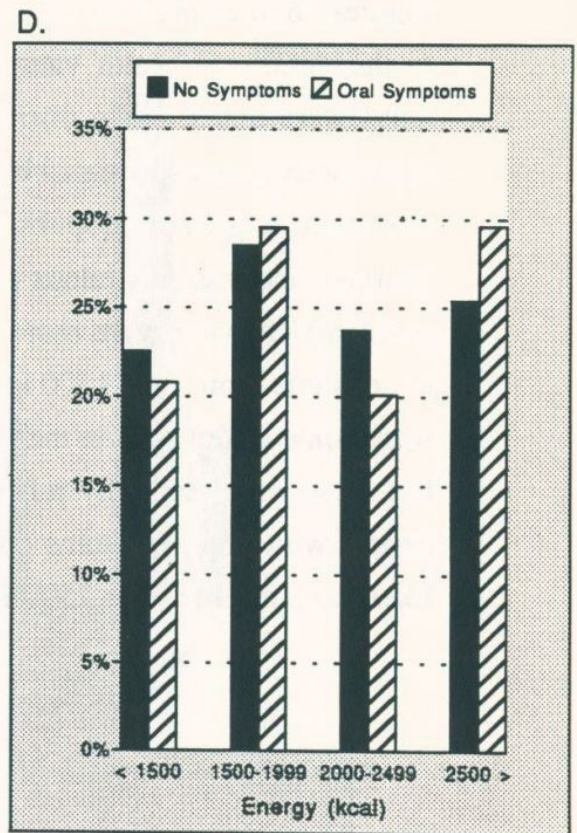
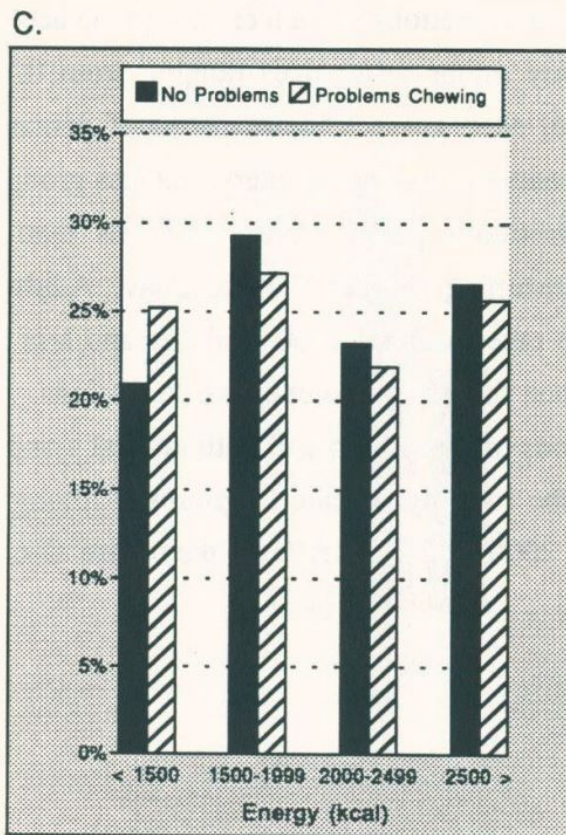
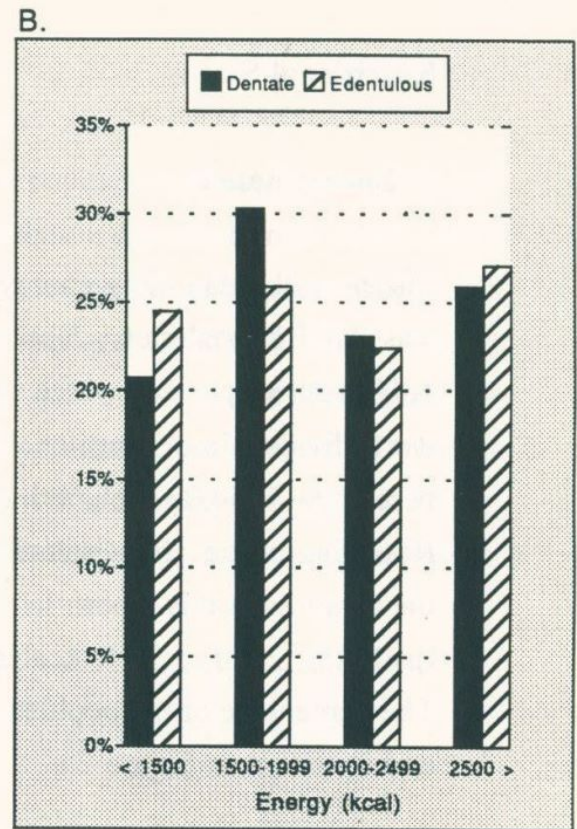
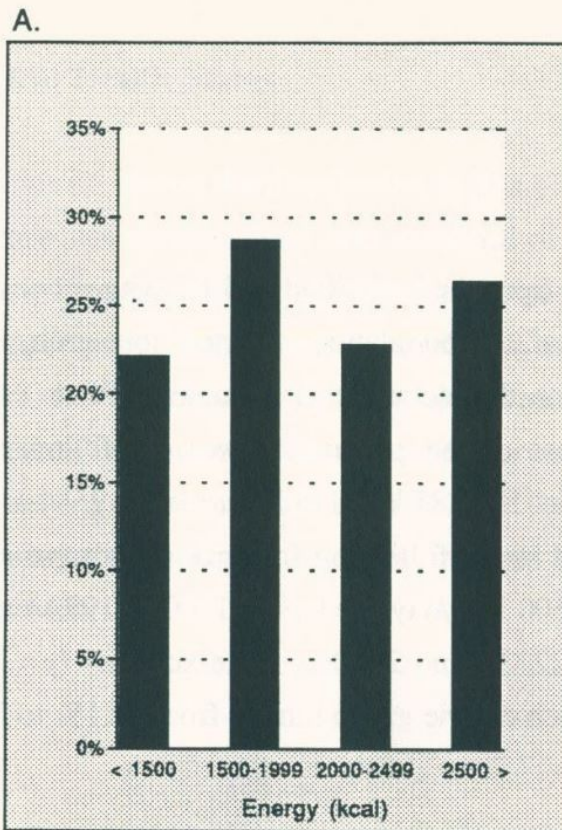


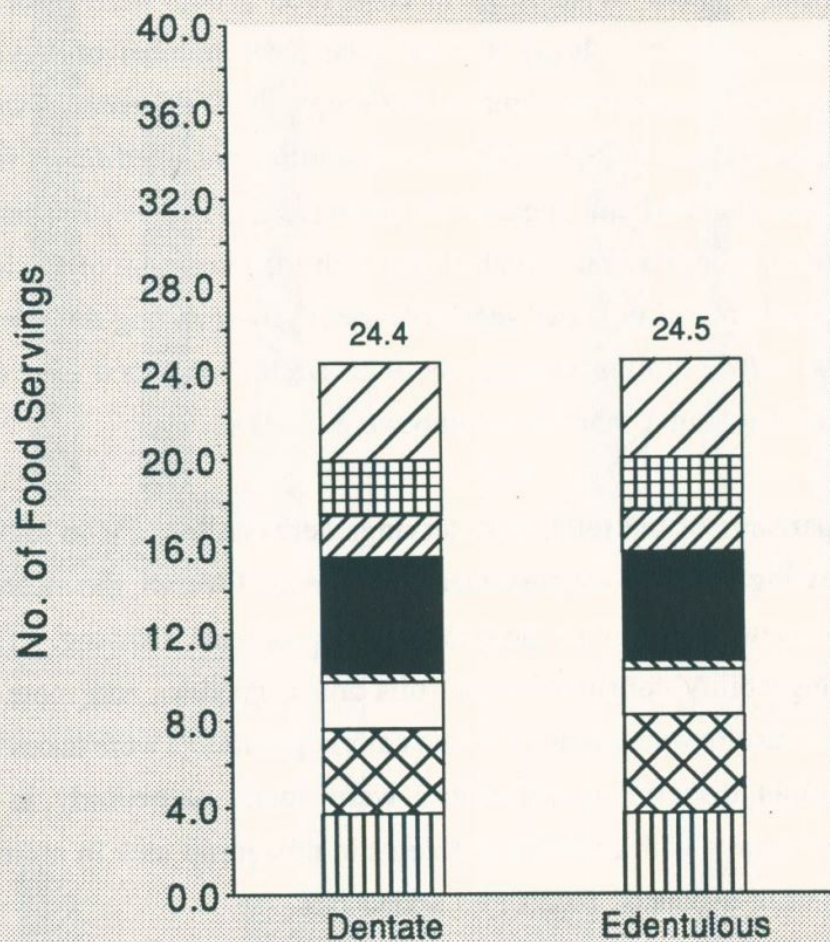
Figure 2. Population Distribution by Calorie Group Overall (a) and According to Dental Status (b), Chewing Ability (c) and Oral Symptoms (d).

2. Food Servings

To examine the influence of oral conditions on food consumption, comparisons of the mean number of servings in each food group were made for the oral health variables. Figure 3 shows that the total mean number of servings for dentate and edentulous persons was identical, although slight differences were observed among some of the food groups. Edentulous adults consumed fewer fruits and vegetables, and more desserts and sugars. As depicted in Figure 4, further analyses according to calorie groups again revealed that with the exception of the lowest calorie group, consumption of fruits and vegetables was lower among the edentulous. In the two highest calorie groups edentulous older adults consumed over one serving more of desserts and sugar than those who were dentate.

Comparisons of the total food servings between those with and without limitations in chewing capacity are presented in Figure 5. Overall, the mean number of servings was somewhat lower in the group with problems chewing. Those with restricted chewing ability consumed less fruits and vegetables and more desserts and sugar. Similar results were obtained when calorie groupings were taken into account (Figure 6). Other discernible differences were noted, particularly in the highest calorie group. Adults with chewing problems in this group took in more breads and cereals, fewer milk products, meats and added fats.

Figure 7 shows that the presence or absence of oral symptoms had no effect on the number of food servings consumed. When broken down by calorie group a few differences emerged (Figure 8). A lower quantity of fruits and vegetables were eaten by adults reporting oral symptoms in the lowest and highest calorie groups. The only other notable difference was in the highest calorie group of desserts and sugar, where those with oral symptoms consumed less servings.



Breads & Cereals	☐	4.5	4.5
Milk Products	▣	2.5	2.4
Meat, Poultry & Fish	▤	1.9	1.9
Fruits & Vegetables	■	5.3	5.0
Mixed Dishes	▥	0.4	0.4
Added Fats	□	2.2	2.1
Desserts & Sugar	⊠	3.9	4.5
Coffee & Tea	▨	3.7	3.7

Figure 3. Mean Daily Number of Food Servings by Dental Status.

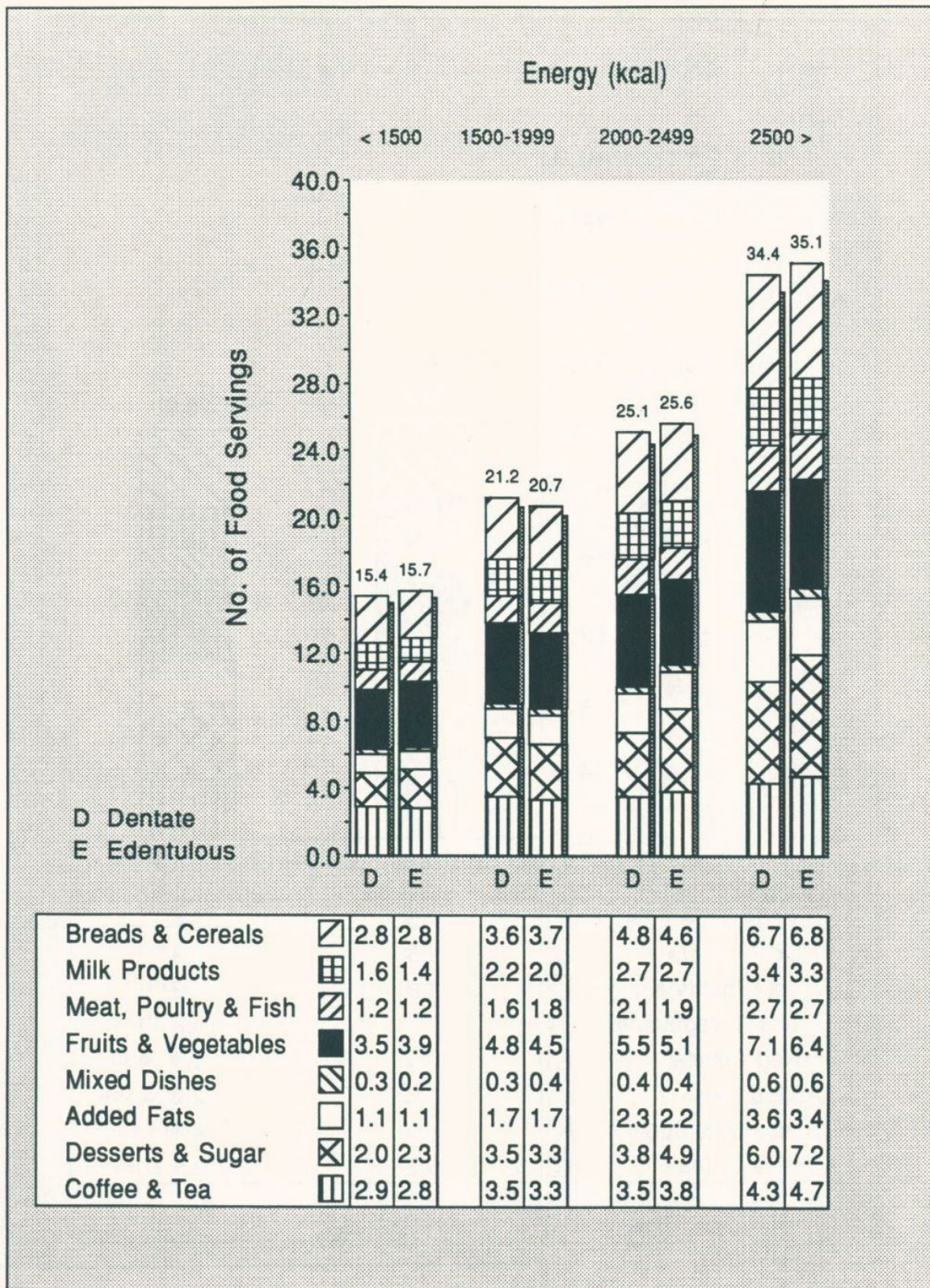


Figure 4. Mean Daily Number of Food Servings by Calorie Group According to Dental Status.

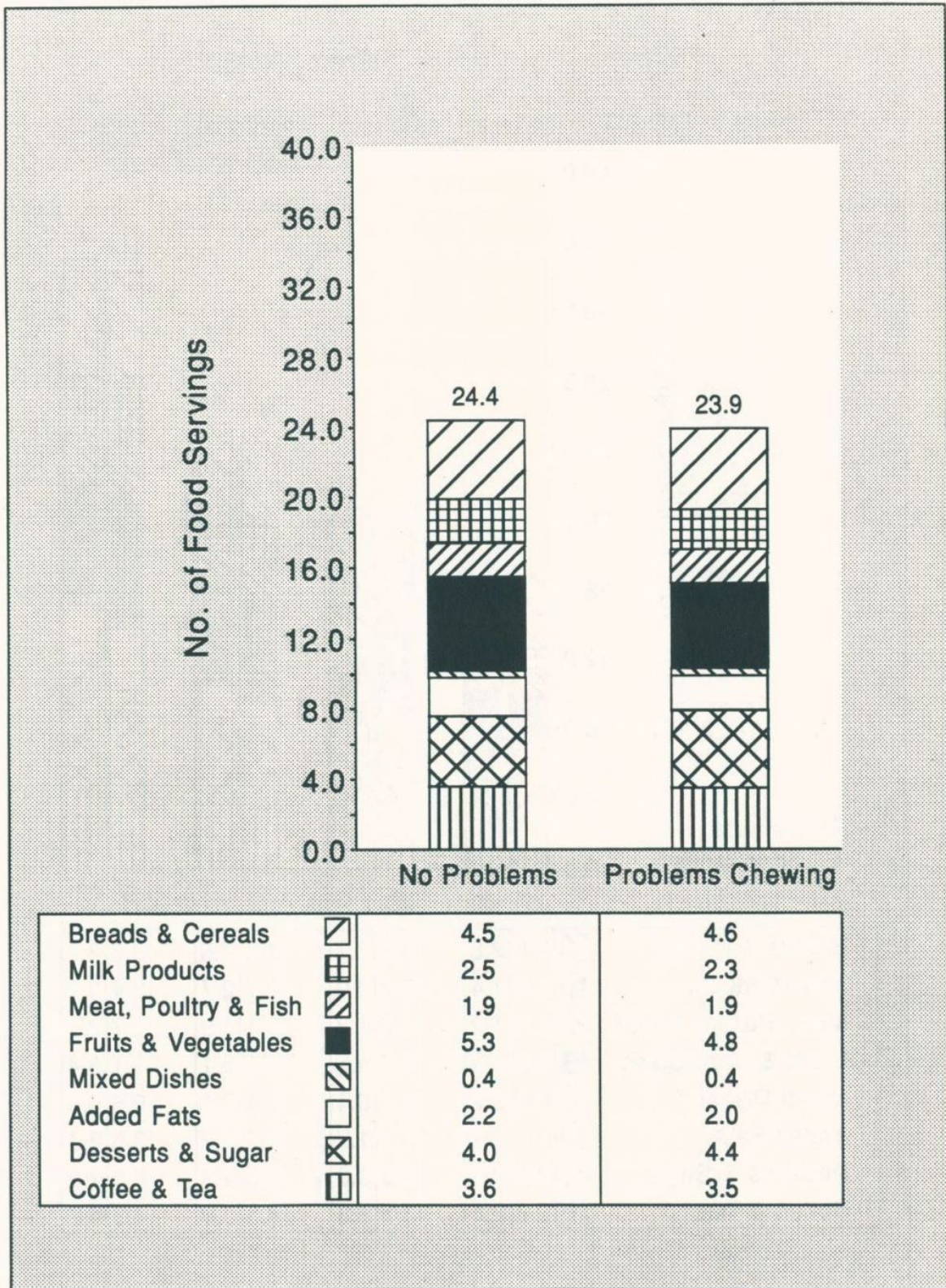


Figure 5. Mean Daily Number of Food Servings by Chewing Ability.

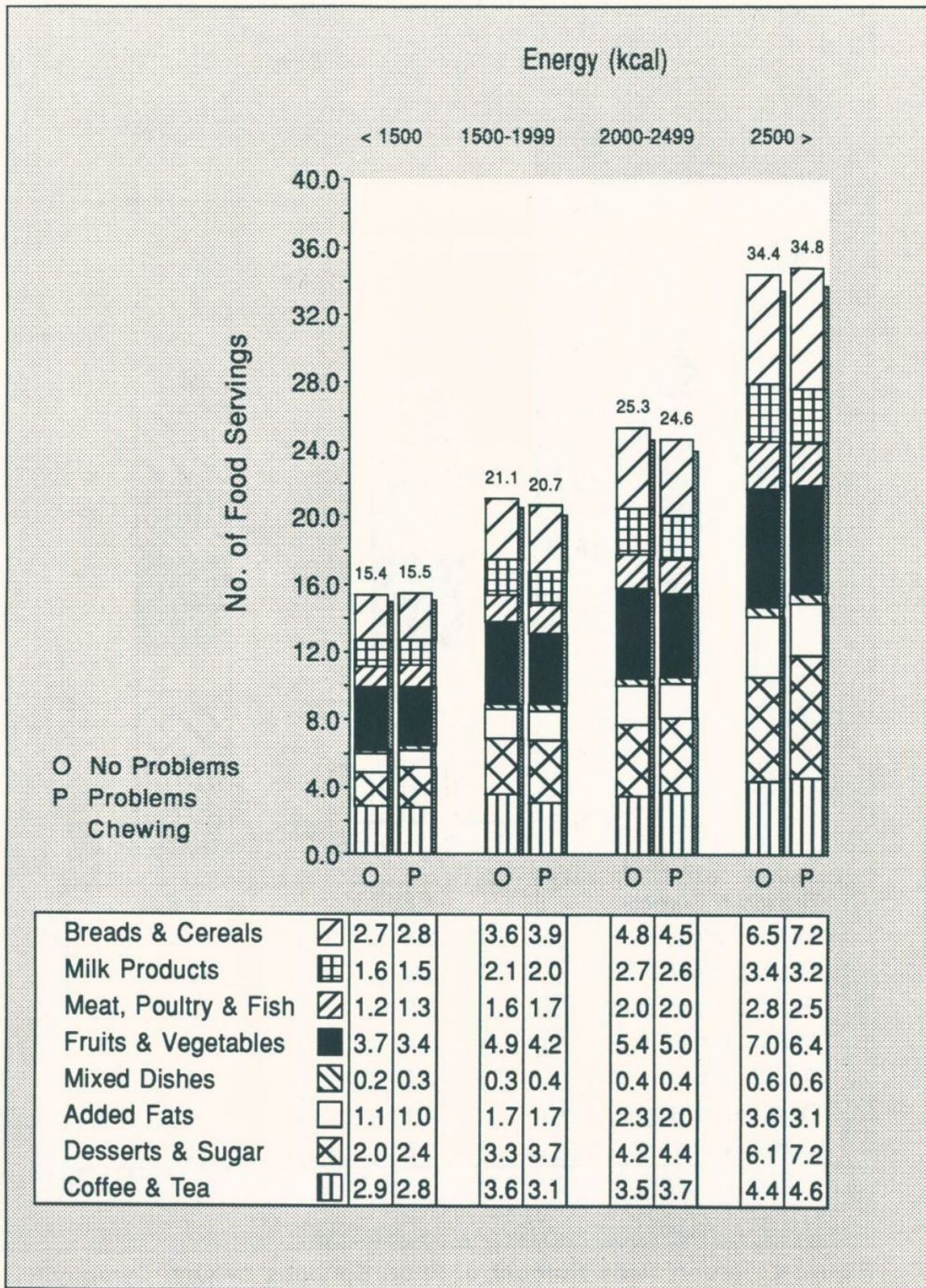


Figure 6. Mean Daily Number of Food Servings by Calorie Group According to Chewing Ability.

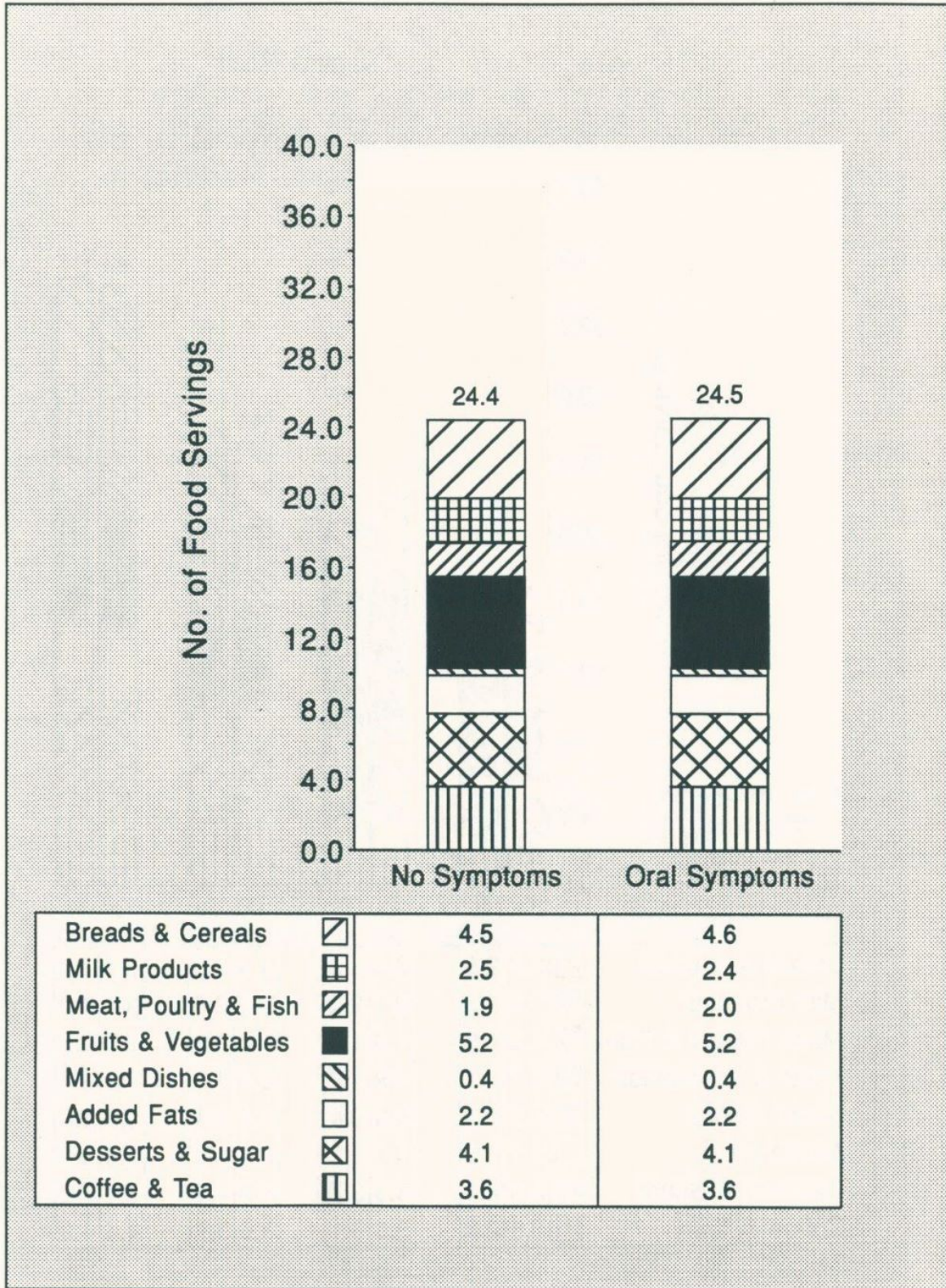


Figure 7. Mean Daily Number of Food Servings by Oral Symptoms.

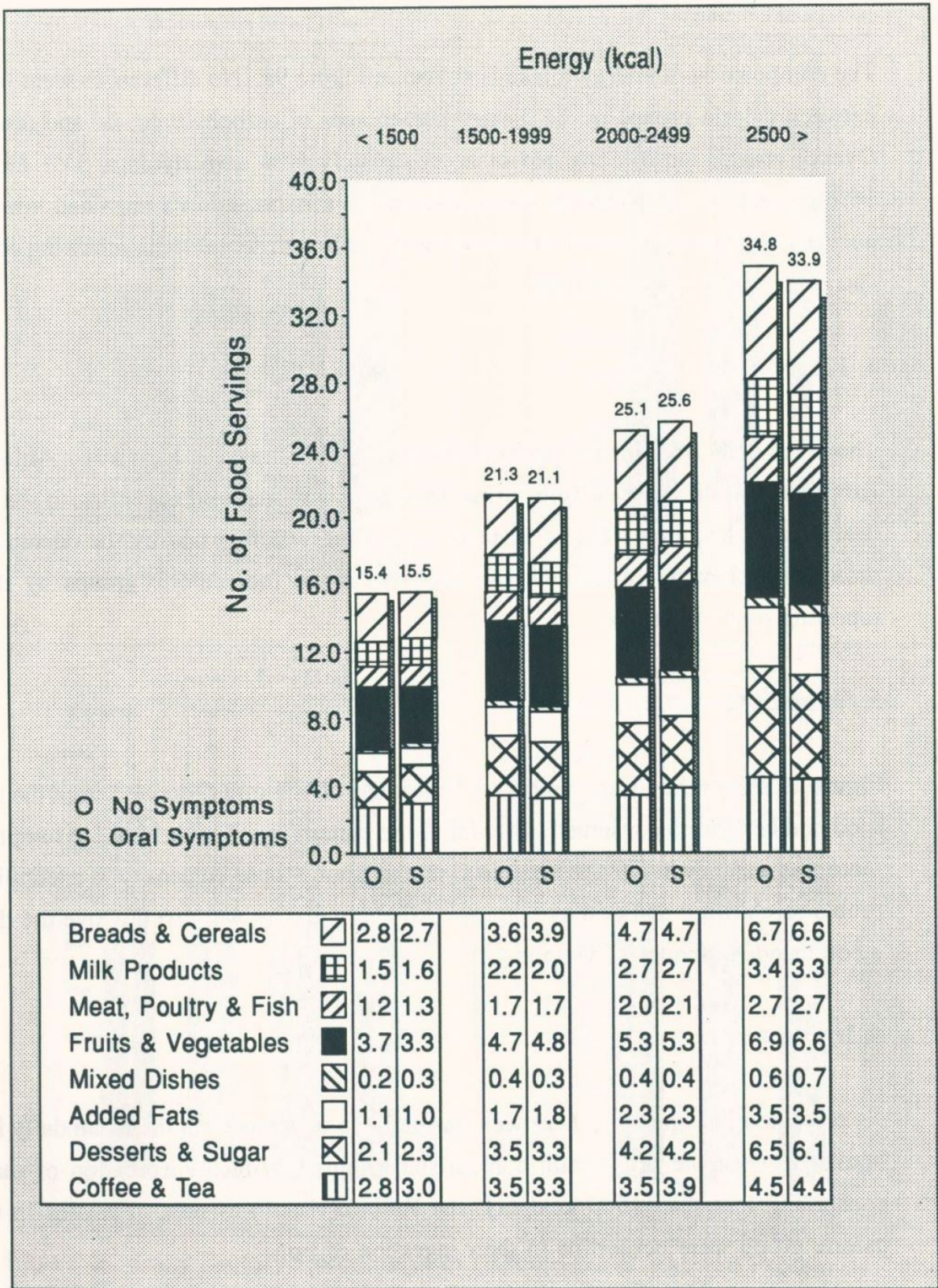


Figure 8. Mean Daily Number of Food Servings by Calorie Group According to Oral Symptoms.

3. Sources of Energy

The composition of energy intake is shown in Figure 9a. No differences were found between calorie groups in the dietary percentages of carbohydrate, fat and protein. Overall energy intake consisted of approximately 50% carbohydrate, 34% fat and 16% protein. As depicted in Figures 9b to 9d, this breakdown remained virtually unchanged when data was further analyzed according to dental status, chewing ability and presence of oral symptoms.

4. Fibre

The mean daily fibre intake expressed in grams is illustrated in Figure 10. Although only marginal differences were found when data was analyzed according to the oral health variables, they were consistent. Less fibre was ingested by the edentulous, those with chewing limitations and in three of the four calorie groups by those reporting oral symptoms.

5. Vitamin C

Figure 11 shows the mean number of milligrams of Vitamin C derived from the total food and beverages consumed. Similar to the pattern found with fibre consumption, there was a somewhat lower Vitamin C intake among those persons with edentulism, problems chewing and oral symptoms. All study groups were well above the daily recommended amount of vitamin C.

6. Iron

As presented in Figure 12, there were virtually no differences in the mean daily iron intake between the oral health comparison groups. With the exception of males consuming less than 1500 kcal/day, the RNI for iron was met. Females in this calorie group were borderline in their ingestion of iron.

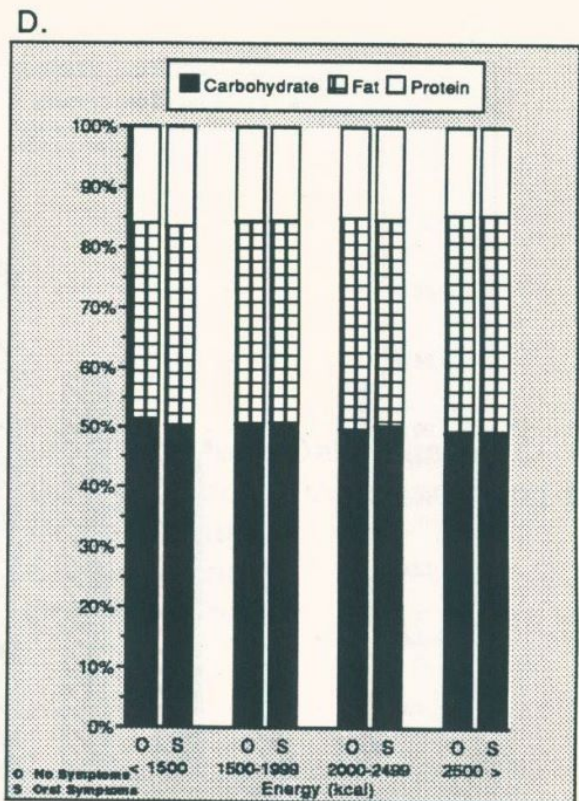
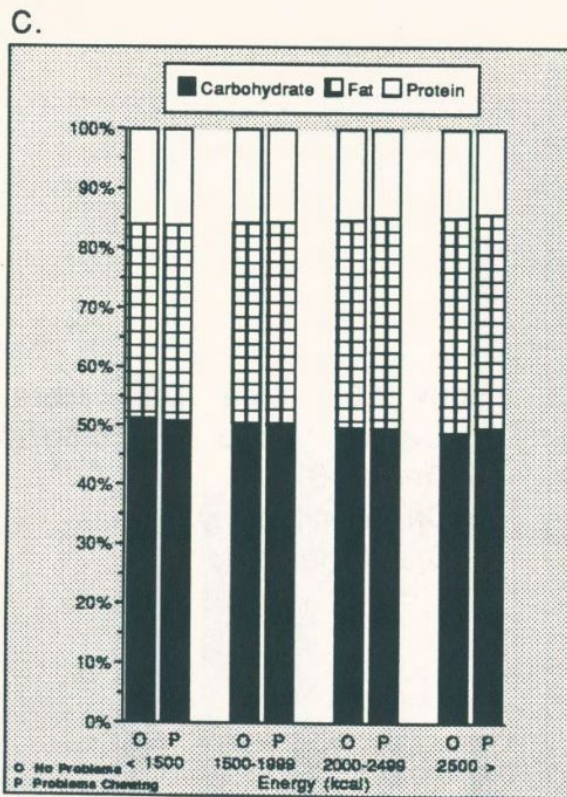
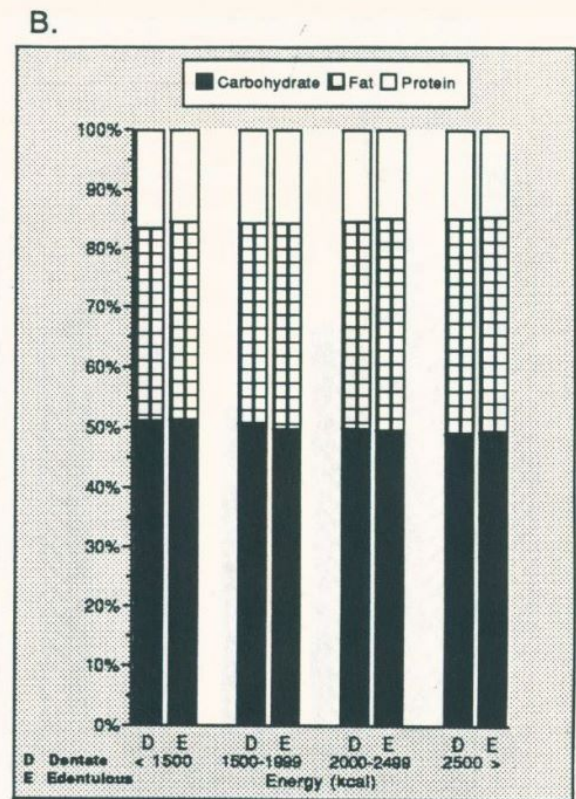
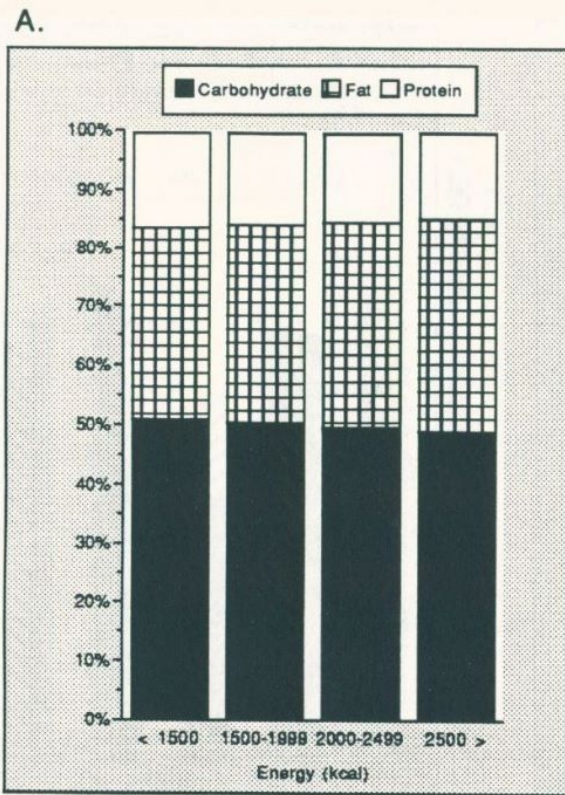
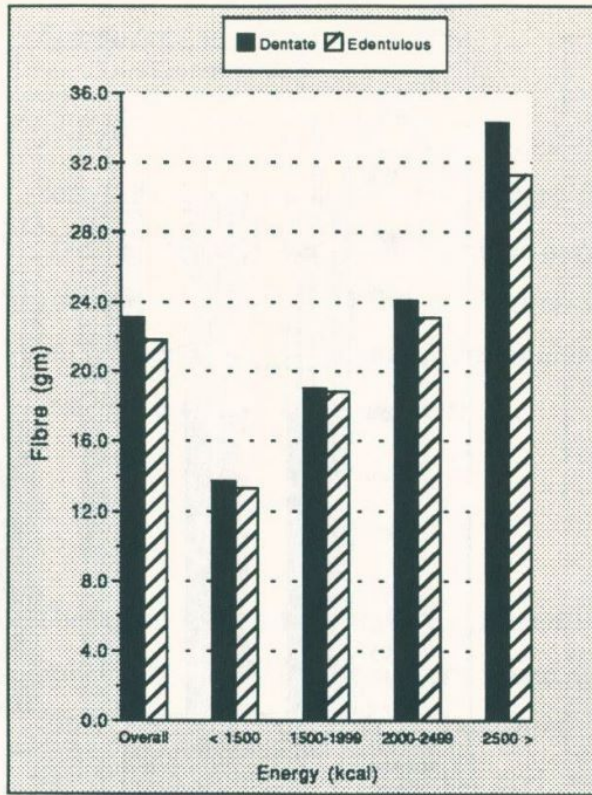
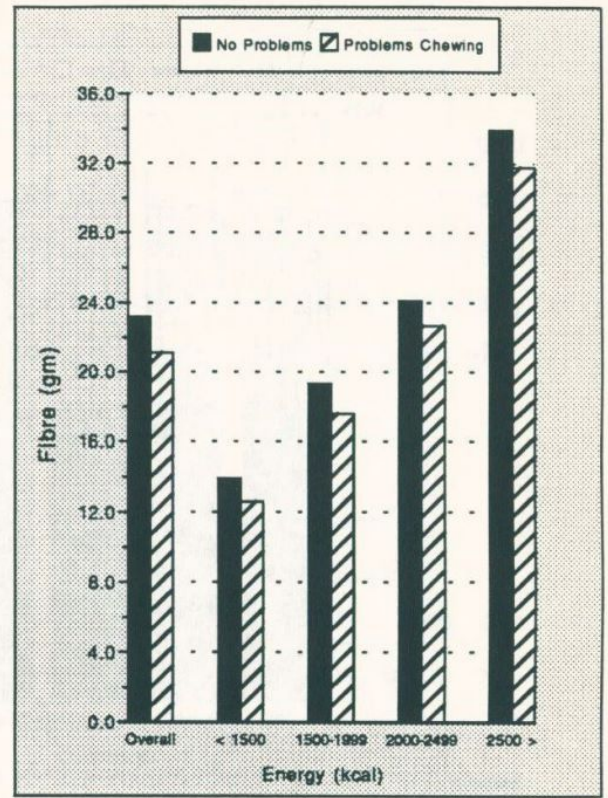


Figure 9. Daily Dietary Percentage of Carbohydrate, Fat and Protein by Calorie Group Overall (a) and According to Dental Status (b), Chewing Ability (c) and Oral Symptoms (d).

A.



B.



C.

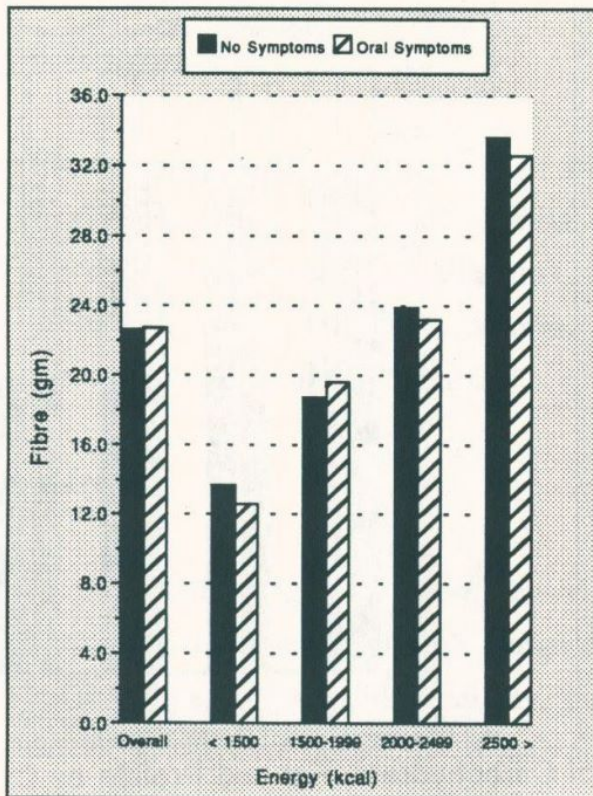
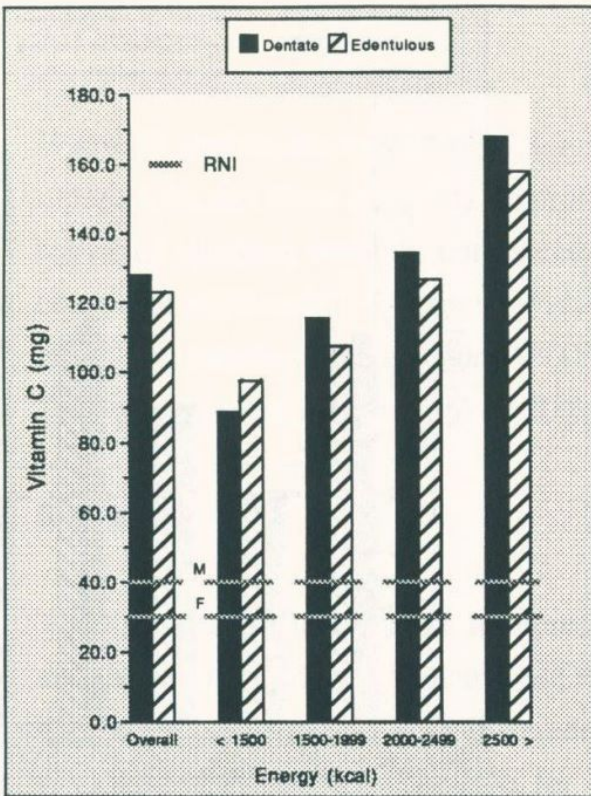
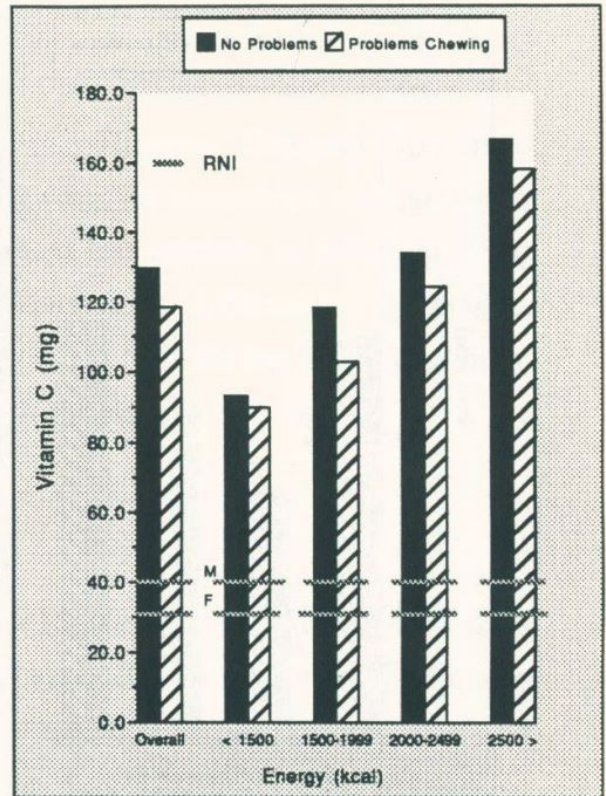


Figure 10. Mean Daily Fibre Intake by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

A.



B.



C.

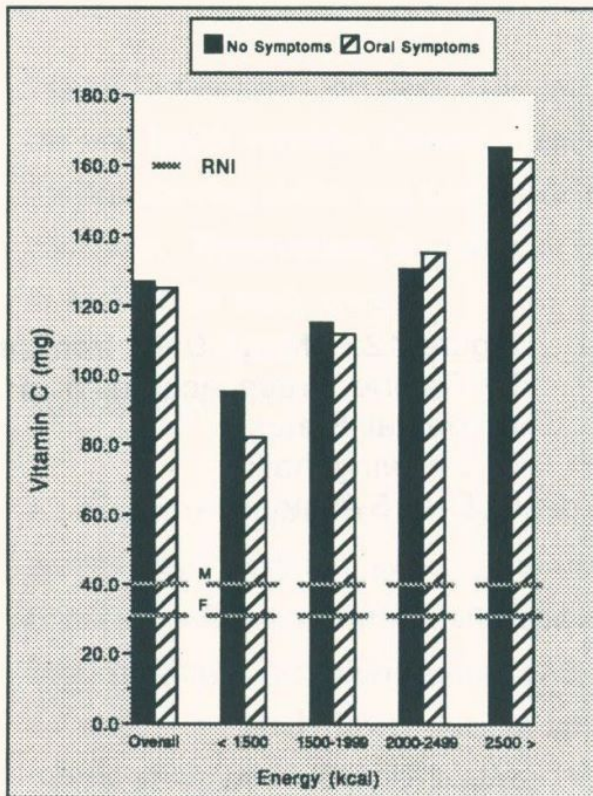
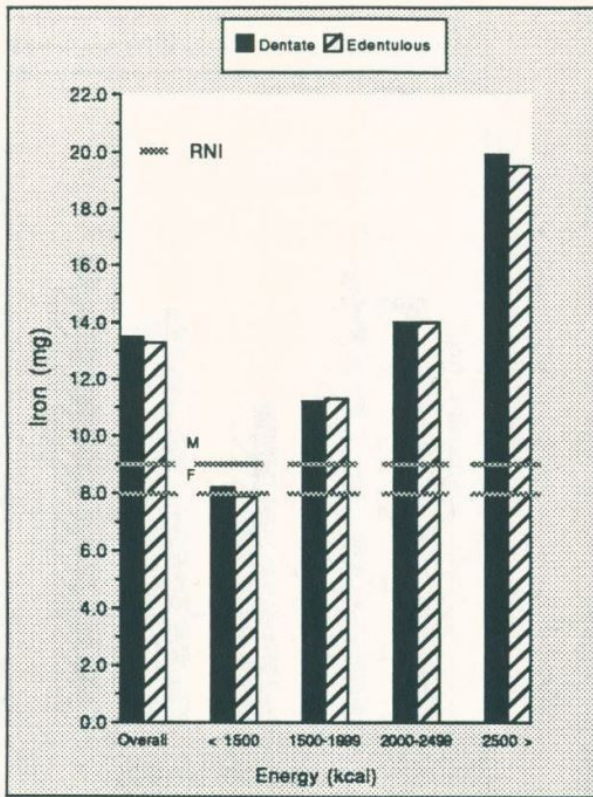
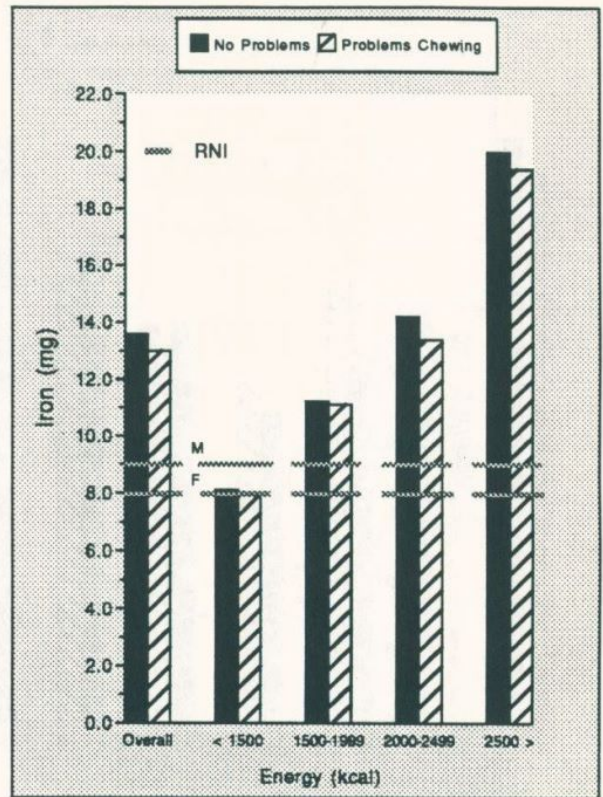


Figure 11. Mean Daily Vitamin C Intake by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

A.



B.



C.

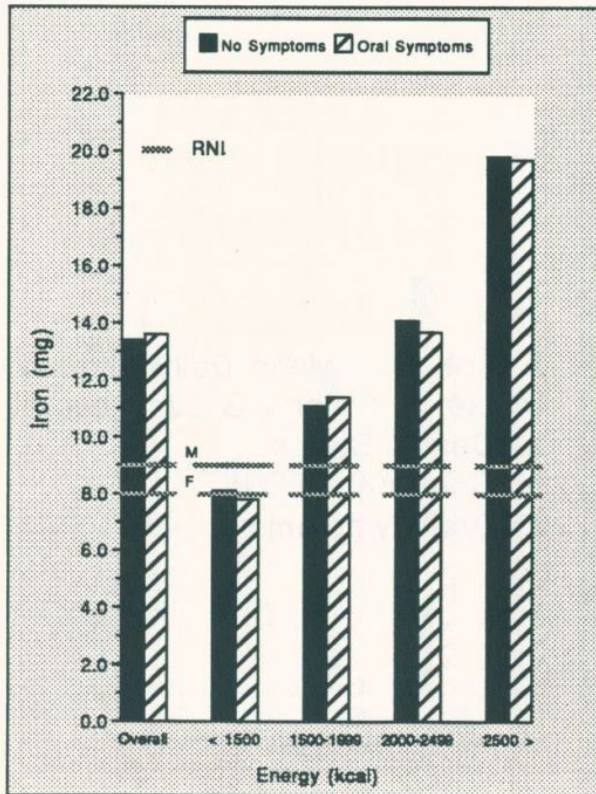


Figure 12. Mean Daily Iron Intake by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

7. Calcium

Figure 13 depicts the mean daily calcium intake in milligrams. Compared to dentate older adults and those reporting no problems chewing, the edentulous and those with restricted chewing capacity consistently consumed less calcium in their diets. No consistent relationship was found with oral symptoms. As indicated on the graphs, the lowest calorie group of under 1500 kcal/day failed to attain the RNI for calcium. This group ingested from 15% to 20% less than the RNI of 800 mg.

8. Niacin

The mean daily niacin intake is represented by Figure 14. Edentulous individuals and those with problems chewing had a slightly lower dietary consumption of niacin than their counterparts. No differences were observed between those with and without oral symptoms. The RNI for niacin was surpassed in all study groups.

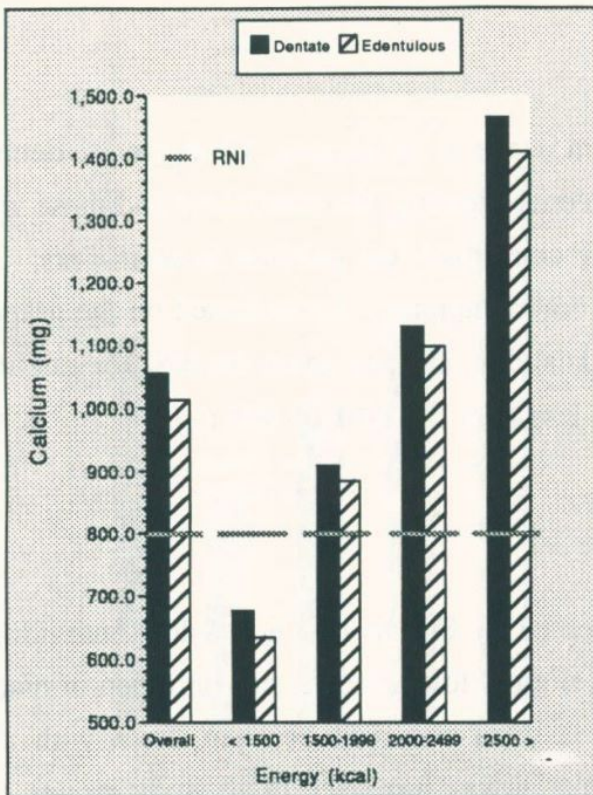
9. Riboflavin

Figure 15 illustrates the mean daily intake of riboflavin. Comparisons according to the oral health variables showed a tendency for edentulous older adults, those with limited chewing ability and those with oral symptoms to take in fewer milligrams of riboflavin. Nevertheless, the intake of riboflavin was above the recommended value in each of the study groups.

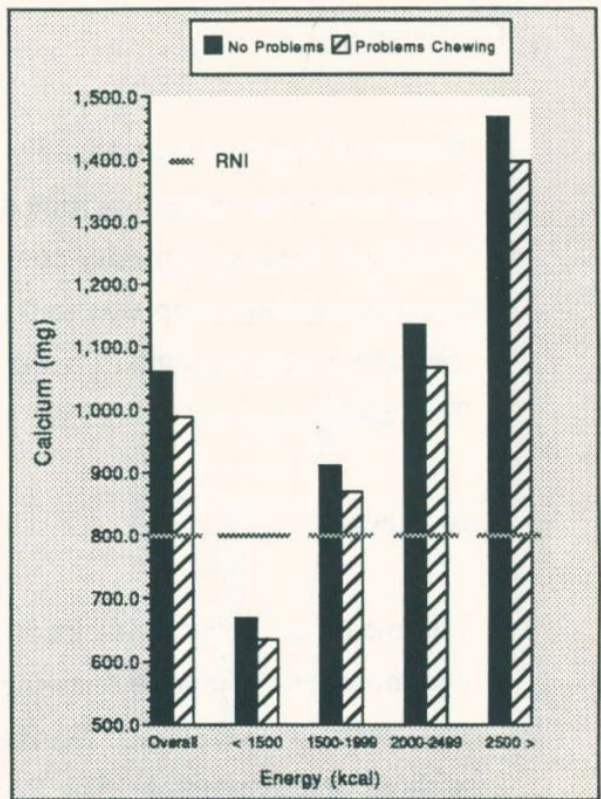
10. Thiamin

As shown in Figure 16, the mean daily thiamin intake was identical in all calorie groups when analyzed according to dental status. Similarly, no differences were found according to chewing ability and oral symptoms in groups consuming less than 2000 kcal/day. The calorie groups of 2000 or more kcal/day with problems chewing did exhibit a slightly lower thiamin intake, as did those with oral symptoms in the calorie group of 2000-2499 kcal/day, but all groups exceeded the RNI for thiamin.

A.



B.



C.

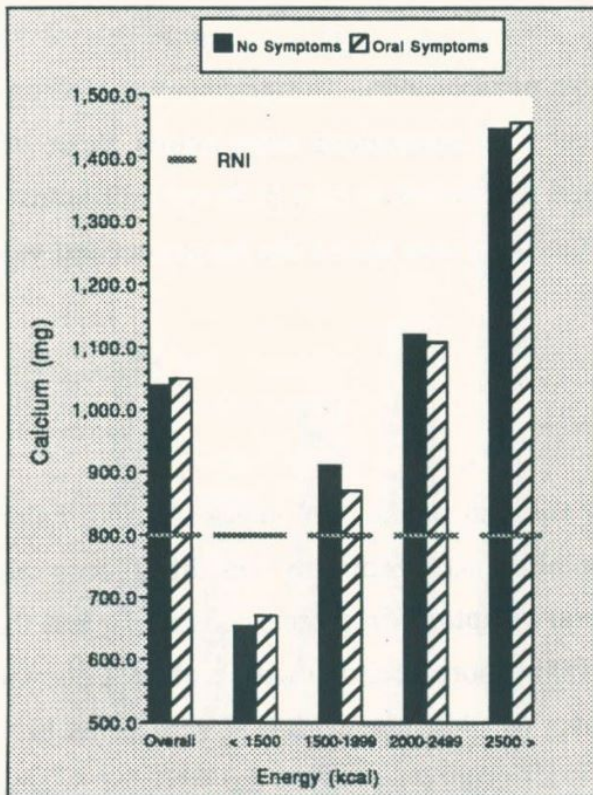
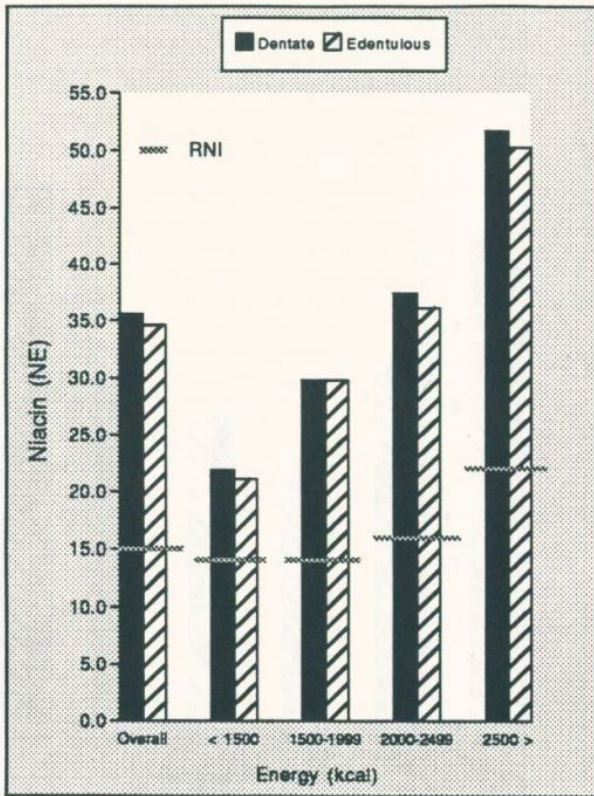
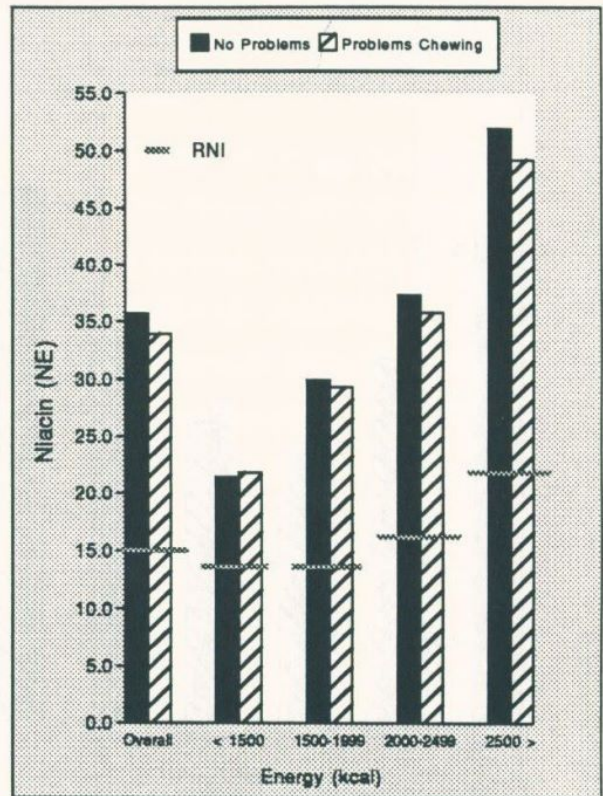


Figure 13. Mean Daily Calcium Intake by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

A.



B.



C.

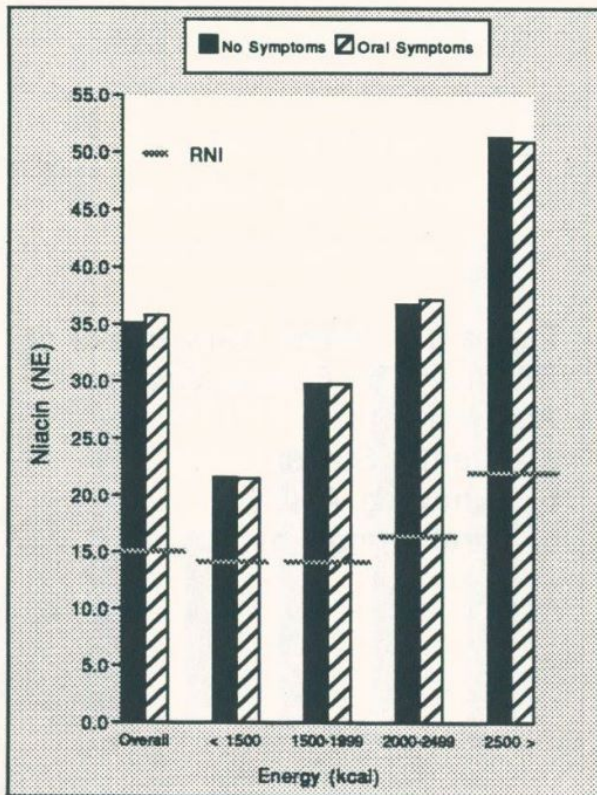
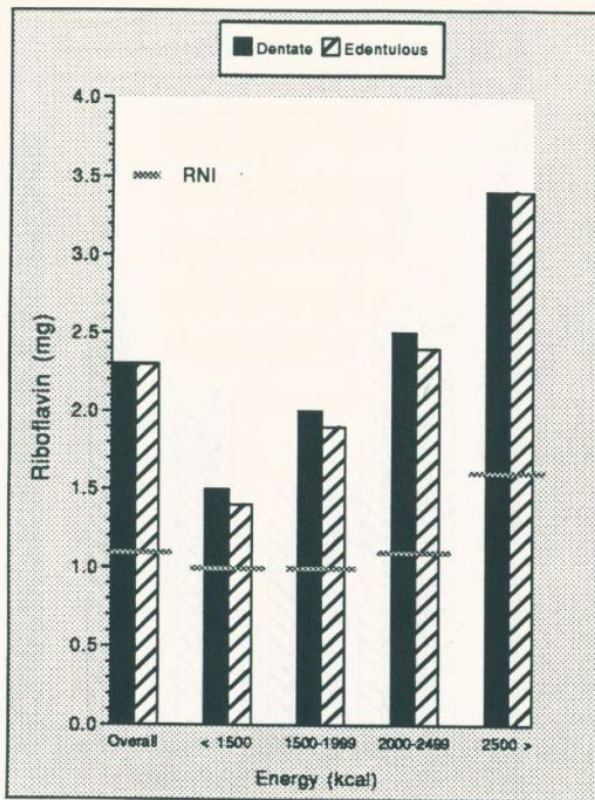
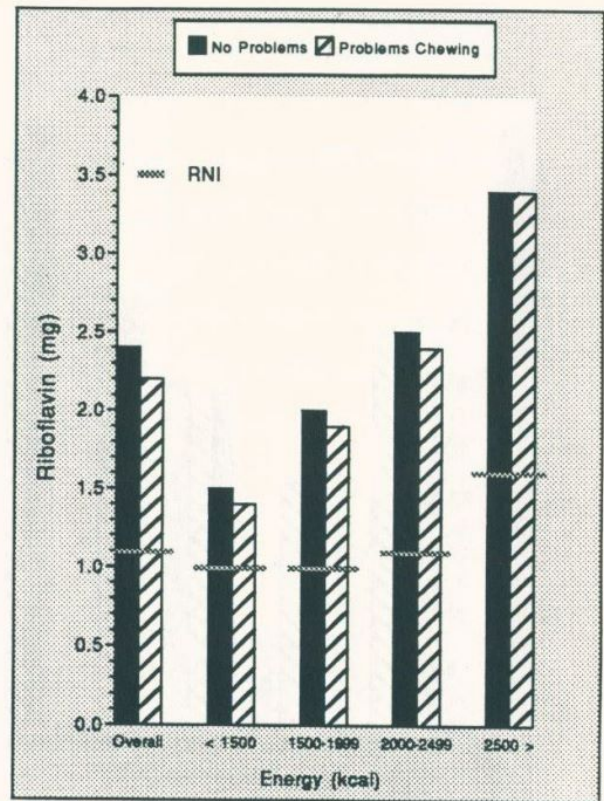


Figure 14. Mean Daily Niacin Intake by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

A.



B.



C.

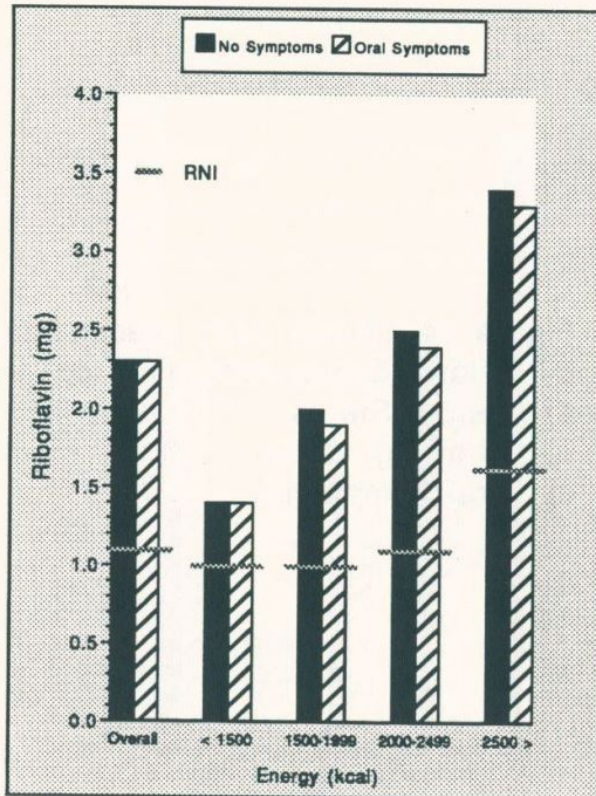
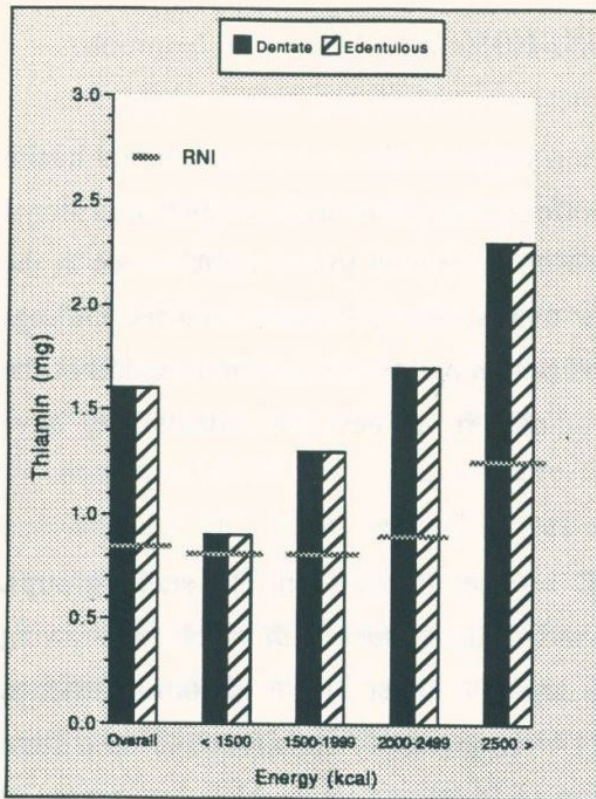
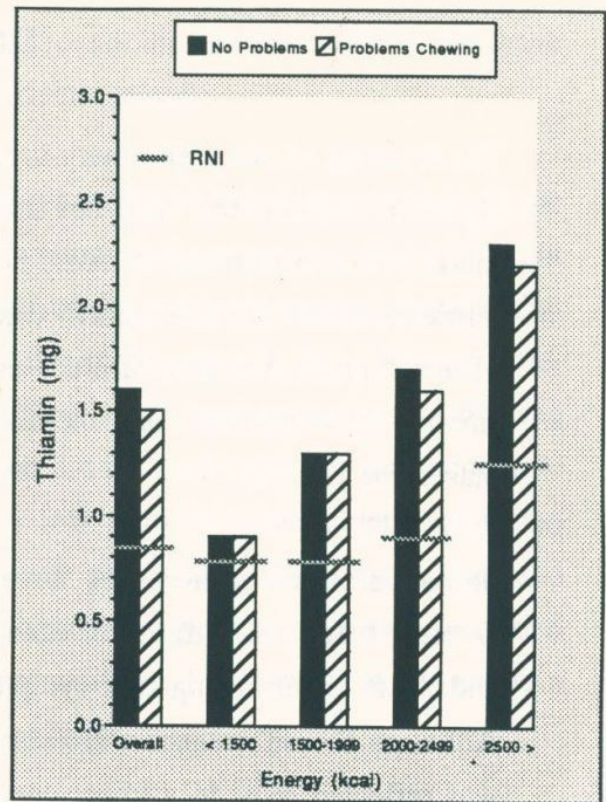


Figure 15. Mean Daily Intake of Riboflavin by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

A.



B.



C.

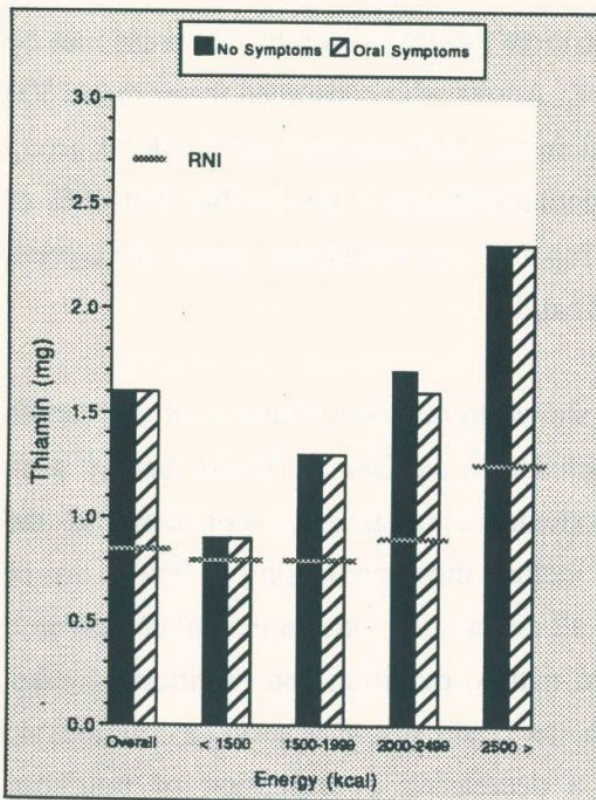


Figure 16. Mean Daily Thiamin Intake by Calorie Group According to:
 a) Dental Status
 b) Chewing Ability
 c) Oral Symptoms

DISCUSSION

The findings of this preliminary investigation suggest that a compromised oral health status in older adults does not have a profound negative impact upon nutritional intake. Oral health factors were not shown to be related to any deficiencies in the nutrients studied in this report. One factor which may have influenced the findings of this study is that 28% of older adults did not complete the nutrition section of the survey. It is possible that the absence of data from these individuals may have biased the results.

Some nutritional differences were found between the oral health study groups. Overall, there was a trend for edentulous individuals, those with problems chewing and those experiencing oral symptoms to report a lower intake of some nutrients. Although the differences were small, they were generally consistent. This pattern was reflected most in a lower consumption of fruits and vegetables, less grams of fibre and fewer milligrams of vitamin C, calcium and riboflavin. Adults with poorer oral health also reported a higher intake of desserts and sugar. Nevertheless, the Recommended Nutrient Intake for the nutrition variables investigated were met by all study groups with only a few exceptions. Adults who consumed fewer than 1500 kcal/day were well under the RNI for calcium. Males in this same calorie group failed to meet the RNI for iron. Of particular concern is the finding that 40% of adults in Ontario aged 65 years or more reported an inadequate intake of calories, i.e. less than the minimum RNI of 1800 kcal/day.

Although subjective indicators have been shown to be good measures of oral health (Locker & Miller, 1994), the measures included in the Ontario Health Survey were limited in their ability to adequately evaluate dental health. For example, the classification of dentate individuals could include those possessing as few as one or two natural teeth. This broad grouping of all dentate individuals may have obscured a possible association between diminished natural dentition and nutritional intake. More accurate measures of oral health status could reveal a stronger relationship between declining oral conditions and a decreasing consumption of nutrients.

Additional measures such as the number of remaining natural teeth would have provided a better quantitative assessment of dental status.

In conclusion, the trends revealed in this report indicate that closer scrutiny of the relationship between oral health and nutrition may be warranted. The slight but consistent differences in the intake of several of the nutrients studied suggest that further research is needed to fully investigate the implications of these findings. For example, it is not known if there is a cumulative effect concerning these observed nutritional differences. Furthermore, this report did not consider other socioeconomic variables and health-related factors such as low income, illness, depression and loneliness, all of which may influence dietary selection, food consumption and nutritional status. Future studies incorporating more comprehensive measures of oral health status, as well as controlling for other influential variables, may provide a more definitive understanding of this complex issue.

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