

## Dietary Intake of Fruits, Vegetables, and Fat in Olmsted County, Minnesota

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- **Objective:** To assess self-reported dietary intake in the adult population of Olmsted County, Minnesota.
- **Subjects and Methods:** We conducted a random-digital telephone survey between March 1 and April 21, 1999, of 1232 adults residing in Olmsted County, Minnesota. We then mailed a structured questionnaire to the survey respondents and achieved a response rate of 732 individuals. Percentages of individuals and predictors of those who meet recommendations for intake of fruits and vegetables and for dietary fats were determined by using  $\chi^2$  tests of general association and multivariate logistic regression.
- **Results:** Only 16% of the population of Olmsted County reported meeting standard dietary recommendations for consuming both 5 or more servings of fruits and/or vegetables per day and no more than 30% of calories

from fat. Fifty-one percent of the population was meeting neither recommendation. Women were more likely than men to report meeting both goals (22% vs 8%,  $P<.001$ ), but still more women were meeting neither goal than were meeting both goals (40% vs 22%,  $P<.001$ ). Multivariate logistic regression revealed the following factors to predict adherence to both goals: female sex, lower body mass index, nonsmoker, history of high cholesterol, and daily physical activity.

- **Conclusion:** Few individuals in Olmsted County are meeting national recommendations for intake of fruits, vegetables, and dietary fat. More effective interventions are needed to improve dietary habits in all subgroups of this community.

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Cardiovascular disease continues to be the leading cause of adult mortality throughout the world.<sup>1,2</sup> Several risk factors for cardiovascular disease are behavior related and modifiable. Four of these risk factors are affected by dietary choices: blood cholesterol level, blood pressure, obesity, and diabetes. National food disappearance data support the hypothesized relationship between dietary fat and cardiovascular disease, suggesting that changes in dietary habits preceded changes in cardiovascular disease mortality by 10 to 20 years.<sup>3</sup>

Dietary guidelines for reducing cardiovascular disease and cancer risk have been widely promoted by national groups. Dietary guidelines from the American Heart Association and the dietary goals outlined in the health objectives for *Healthy People 2010*, for instance, recom-

mend a diet with 5 or more servings of fruits and vegetables per day, with no more than 30% of calories from fat.<sup>4,5</sup> Although there is general agreement on the public health importance of these dietary goals, their application in the US population has been less than ideal. Data from a 16-state survey in 1996, reported by Li et al,<sup>6</sup> showed that only 23% of adults reported consuming 5 or more servings of fruits and/or vegetables per day. National data suggest that approximately 33% of persons 2 years and older consume no more than 30% of calories from fat, well below the goal of 75% set in *Healthy People 2010*.<sup>5</sup> Less is known about who in the population is meeting both dietary goals for the intake of fruits, vegetables, and fat.

As part of CardioVision 2020, a community health initiative to help residents of Olmsted County, Minnesota, attain the lowest cardiovascular disease morbidity and mortality rates in the United States by the year 2020,<sup>7</sup> we performed a community survey to assess the prevalence of cardiovascular disease risk factors among adult Olmsted County residents. For purposes of this report, we sought to answer the following questions: What percentage of the population is consuming 5 or more servings of fruits and/or vegetables each day and consuming less than 30% of total calories from fat? What are the characteristics of those in the community who meet both fruit and/or vegetable and dietary fat goals?

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## SUBJECTS AND METHODS

### Survey Procedures

A random-digit-dial telephone survey of 1232 adult residents of Olmsted County, Minnesota, was performed between March 1 and April 21, 1999, using survey methods that have been described previously.<sup>7,8</sup> Survey tasks were performed by SNG Research, a survey research organization based in Rochester, Minn. The sampling frame consisted of 6000 telephone numbers purchased from Survey Sampling Inc (Fairfield, Conn). Sampling was balanced to collect data on approximately 100 persons in each of 12 age-sex groups (20-29, 30-39, 40-49, 50-59, 60-69, and  $\geq 70$  years for both men and women). The community survey tool included items from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System survey<sup>9</sup> that were related to cardiovascular disease and its risk factors to allow comparisons between Olmsted County and state and national data. Six of these items contained questions that allowed for calculation of the number of fruits and vegetables consumed by each individual on a typical day.

Respondents who completed the original telephone survey were also asked to complete a separate, mailed food frequency questionnaire (Quick Check for Diet Progress by Nutrition Scientific, South Pasadena, Calif).<sup>10</sup> This questionnaire contains items that allow for estimation of the percentage of daily caloric intake that is derived from fat and the main food sources of dietary fat for each individual. Because respondents to the Quick Check for Diet Progress can only report up to 6 servings of fruits and/or vegetables eaten on a typical day, we used data obtained from the community survey to estimate fruit and vegetable intake for respondents. Results from the community survey, in fact, showed higher mean intake of fruits and vegetables compared with the results from the Quick Check for Diet Progress survey (mean servings of fruits and vegetables per day were 4.3 from the community survey data and 2.9 from the Quick Check data,  $P < .001$ ).

Of 1095 community survey respondents who expressed a willingness to complete the nutrition survey, 770 (70%) returned completed questionnaires. Thirty-eight of these respondents were excluded because their sex or age responses indicated that a person other than the intended respondent had completed the questionnaire, leaving 732 individuals (59% of the original 1232) with data that were included in this report. Response rates were between 59% and 72% of all women and men older than 49 years but only 47% in men 30 to 49 years of age and only 27% for those 20 to 29 years of age. No attempt was made to validate or verify the self-reported responses of the survey participants.

### Data Analysis

**Statistical Weighting.**—Data obtained from respondents were weighted to match the relative proportions of age and sex groups from the 1999 Olmsted County population based on US Census estimates. Since weighted and unweighted data were similar, results reported in this article are limited generally to weighted data.

**Nutrition Groups.**—As part of our analysis, respondents were divided into 1 of 4 categories that were based on whether the respondent was currently meeting the 2 dietary goals included in this report (goal 1, 5 or more servings of fruits and/or vegetables per day; goal 2, no more than 30% of calories from fat). Group 1 included persons who met goal 1 only; group 2, persons who met goal 2 only; group 3, persons who met both goals; and group 4, persons who met neither of the 2 goals.

**Univariate Analysis.**—Mean daily intake of fruits and vegetables was estimated from the community survey tool, as described herein, and the percentage of calories from fat was estimated for each individual using the Quick Check for Diet Progress. These data were compared by age and sex groups for all 732 respondents who returned mailed nutrition surveys. In addition, characteristics of individuals in each of the 4 nutrition groups were compared by using  $\chi^2$  tests. The agreement between meeting the fruits and vegetables goal (goal 1) and meeting the dietary fat goal (goal 2) was calculated by using the  $\kappa$  coefficient.

**Age and Sex Dependence.**—The age and sex dependence of the probability of meeting goals 1 and 2 was modeled with use of logistic regression (proc catmod, SAS Institute Inc, Cary, NC).

**Predictors of Adherence to Dietary Recommendations.**—The probability of being in each of groups 1, 2, and 3 was compared with the probability of being in group 4 by using multinomial logistic regression (proc catmod, SAS Institute Inc). Initial analyses included the following independent variables: age, sex, race, body mass index (BMI), history of hypertension, history of high cholesterol, history of diabetes, history of coronary heart disease, history of stroke, smoking, daily activity, received weight loss advice, received dietary advice, received exercise advice, perceived cardiovascular risk, and perceived health as very good. The final analyses included only the subset of variables that was found to be statistically significant. Group 3 was tested for whether it was consistent with being the independent overlap of individuals meeting goal 1 and individuals meeting goal 2 by using a  $\chi^2$  test of whether the group 3/group 4  $\beta$  values were equal to the sum of the group 1/group 4 and the group 2/group 4  $\beta$  values in the multinomial logistic regression. Finally, a logistic regression was run comparing the union of groups 1, 2, and 3 to group 4.

**RESULTS**

Characteristics of all respondents included in this analysis are shown in Table 1. Among the 732 respondents, 404 (55%) were women and 328 (45%) were men. Ninety-six percent of the group was self-described as non-Hispanic whites. The mean age of the group was 52.2 years, with a range of 20 to 91 years. Obesity (BMI >30 kg/m<sup>2</sup>) (17%), a history of high blood pressure (30%), and high blood cholesterol (32%) were fairly common. A history of diabetes was reported by 5%, and a history of previous coronary heart disease was reported by 9% of respondents. Fifteen percent of the group reported current cigarette smoking, 57% reported performing daily physical activity, and 14% had received advice to lose weight. Table 1 also shows the corresponding proportions weighted to the 1999 Olmsted County population.

More women (35%) than men (19%) met the goal of consuming at least 5 servings of fruits and/or vegetables (*P*<.001, Figure 1). Among both men and women, logistic regressions confirmed that older respondents tended to meet the goal more often than younger respondents (men:  $\beta=0.027$  for age, *P*=.002; women:  $\beta=0.021$  for age, *P*<.001). Among men, intake of fruits and/or vegetables was lowest in those aged 20 to 29 years (11% meeting the goal of at least 5 servings a day), whereas intake was highest in men 70 years and older (34% meeting the goal of at least 5 servings a day). The proportion of women meeting goal 1 ranged from 18% in the 20- to 29-year-old age group to 48% among those 70 years and older.

Women (47%) were also more likely than men (26%) to consume no more than 30% of total calories from fat (*P*<.001). In contrast to the data on intake of fruits and/or vegetables, however, there was no statistically significant age variation detected in the proportion of individuals within each sex group who met the dietary fat goal.

The percentage of persons who reported meeting the 2 dietary recommendations included in this analysis was low for the entire group of respondents. Although 49% of respondents met at least 1 of the 2 goals, only 16% met both goals, and 51% met neither goal. The agreement between meeting each of the goals was modest but still significant ( $\kappa$  coefficient, 0.25; 95% confidence interval, 0.18-0.32).

The proportion of the population in each of the 4 nutrition groups for selected characteristics is shown in Table 2. The probability value for a  $\chi^2$  test of general association is also shown. Age, sex, race, BMI, a history of high cholesterol, smoking status, daily physical activity, and having received weight loss advice all tested as having a statistically significant association with the nutrition group. A history of hypertension, a history of diabetes, a history of coronary heart disease, as well as the other variables listed in the "Methods" section showed no significant association.

**Table 1. Self-reported Characteristics of Study Participants\***

Characteristic	Unweighted (n=732)	Weighted†
Age, mean (range) (y)	52.2 (20-91)	45.4 (20-91)
Female	55	52
Non-Hispanic white	96	95
Obese (body mass index >30 kg/m <sup>2</sup> )	17	17
High blood pressure	30	25
High blood cholesterol	32	27
Diabetes	5	3
Coronary heart disease	9	5
Current cigarette smoking	15	16
Daily physical activity	57	57
Received weight loss advice	14	13

\*Data are expressed as percentages unless indicated otherwise.

†Survey data were weighted to match the relative proportions of age and sex groups from the 1999 Olmsted County, Minnesota, population based on US Census estimates.

Multinomial logistic regression modeling of the probability of groups 1, 2, and 3 divided by the probability of group 4 showed that age, sex, race, BMI, a history of high cholesterol, smoking status, and daily physical activity were significant predictors of adherence to 1 or more of the dietary recommendations (Table 3). Having received weight loss advice was only a significant predictor when groups 1, 2, and 3 were combined in the comparison with group 4. Being female, having a history of high cholesterol, and performing daily physical activity increased the relative probability of meeting both goals. Smoking and increasing BMI reduced the relative probability. Increasing age was found to significantly increase the relative probability of being in group 1 (*P*<.001) but not group 2 (*P*=.62). Non-Hispanic whites had a lower group 2 relative probability (*P*<.001), but the effect on group 1 probabilities

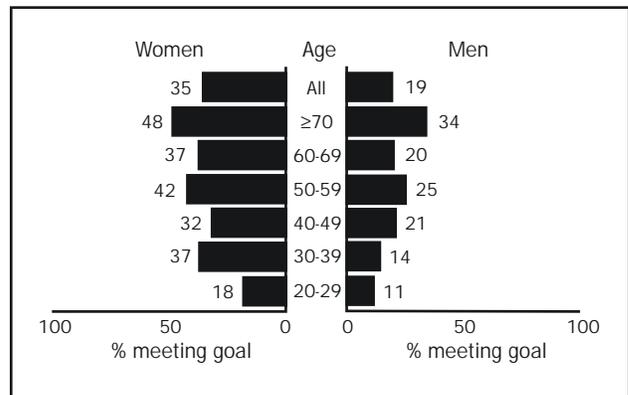


Figure 1. Proportion of adults from Olmsted County, Minnesota, reporting consumption of 5 or more servings of fruits and/or vegetables per day by sex group (weighted data).

Table 2. Proportion in Each Nutrition Group for Selected Characteristics (Weighted Data)\*

Characteristic	Group 1 (unweighted n=97)	Group 2 (unweighted n=158)	Group 3 (unweighted n=122)	Group 4 (unweighted n=355)	P value (for general association)
Total population	12 (1)	21 (2)	16 (1)	51 (2)	
Age group (y)					
20-29	4 (2)	31 (5)	10 (3)	54 (5)	.005
30-39	10 (3)	20 (4)	15 (3)	54 (5)	
40-49	11 (3)	17 (3)	15 (3)	56 (5)	
50-59	15 (3)	18 (3)	18 (3)	49 (4)	
60-69	13 (3)	24 (4)	16 (3)	47 (4)	
≥70	21 (4)	20 (3)	22 (4)	37 (4)	
Sex					
Female	12 (2)	25 (2)	22 (2)	40 (2)	<.001
Male	11 (2)	18 (2)	8 (2)	63 (3)	
Race					
White	12 (1)	20 (2)	16 (1)	52 (2)	<.001
Other	8 (5)	49 (10)	10 (6)	33 (9)	
Body mass index (kg/m <sup>2</sup> )					
≤25	9 (2)	26 (2)	18 (2)	46 (3)	.003
>25	14 (2)	17 (2)	14 (2)	55 (2)	
≤30	11 (1)	24 (2)	17 (2)	49 (2)	<.001
>30	15 (3)	10 (3)	10 (3)	65 (4)	
History of hypertension					
Yes	12 (2)	21 (3)	17 (3)	50 (3)	.87
No	12 (1)	22 (2)	15 (2)	52 (2)	
History of high cholesterol					
Yes	12 (2)	26 (3)	22 (3)	40 (3)	.002
No	12 (1)	20 (2)	13 (2)	55 (2)	
History of diabetes					
Yes	16 (6)	29 (8)	12 (5)	43 (8)	.62
No	12 (1)	21 (2)	16 (1)	52 (2)	
History of coronary heart disease					
Yes	14 (4)	22 (5)	20 (5)	44 (6)	.75
No	12 (1)	21 (2)	15 (1)	52 (2)	
Smoker					
Yes	9 (3)	23 (4)	7 (2)	62 (5)	.01
No	12 (1)	21 (2)	17 (2)	49 (2)	
Daily physical activity					
Yes	12 (2)	22 (2)	21 (2)	44 (2)	<.001
No	11 (2)	20 (2)	9 (2)	61 (3)	
Received weight loss advice					
Yes	21 (4)	17 (4)	19 (4)	44 (5)	.01
No	10 (1)	22 (2)	15 (1)	52 (2)	

\*Data are presented as percentage (SEM). Group 1 includes those meeting the goal of 5 or more servings of fruits and/or vegetables per day only; group 2, those meeting the goal of 30% or less of calories from fat only; group 3, those meeting both goals; and group 4, those meeting neither goal.

was not statistically significant ( $P=.18$ ). Both age and race were significant when groups 1 through 3 were combined ( $P=.002$  and  $P=.009$ , respectively). When all  $\beta$  values were jointly compared to test whether group 3 was consistent with being the independent overlap of meeting the individual goals, the hypothesis of independence was rejected ( $P<.001$ ). When individual  $\beta$  values were examined to explore the nature of this deviation from independence, age ( $P=.09$ ) and race ( $P=.053$ ) were found to have the most significant deviations. Neither, however, met the  $P=.05$  level of statistical significance, so further data would be needed to confirm that these are the primary sources of the deviation.

## DISCUSSION

Results of our community survey of dietary habits of adults in Olmsted County, Minnesota, show that only a minority of the population is achieving levels of intake of fruits, vegetables, and dietary fat that have been recommended by health organizations to help reduce the risk of cardiovascular disease. Consistent with other reports,<sup>5,6,11,12</sup> we found that reported adherence to dietary guidelines varied by age and sex, with the better dietary habits generally reported in women and older adults. However, even in women and older adults in our population sample, low adherence to national dietary guidelines was common, suggesting that

Table 3. Results of Logistic Regressions for Prediction of Nutrition Group Probabilities (Weighted Data)\*

Characteristic	OR (95% CI)			
	Group 1 vs group 4	Group 2 vs group 4	Group 3 vs group 4	Groups 1-3 vs group 4
Age	1.03 (1.02-1.05)	1.00 (0.99-1.01)	1.01 (1.00-1.03)	1.01 (1.00-1.02)
Female	1.87 (1.15-3.04)	2.19 (1.47-3.28)	4.35 (2.67-7.10)	2.45 (1.78-3.37)
Non-Hispanic white	0.52 (0.14-1.92)	0.24 (0.11-0.53)	0.70 (0.20-2.47)	0.33 (0.16-0.71)
Body mass index	1.03 (0.98-1.08)	0.92 (0.88-0.96)	0.95 (0.90-1.00)	0.94 (0.91-0.98)
History of high cholesterol	0.96 (0.54-1.69)	2.17 (1.36-3.45)	2.09 (1.24-3.51)	1.62 (1.12-2.35)
Smoker	0.66 (0.33-1.33)	0.74 (0.44-1.25)	0.28 (0.13-0.62)	0.57 (0.37-0.87)
Daily physical activity	1.60 (0.98-2.61)	1.42 (0.96-2.12)	3.26 (1.98-5.36)	1.80 (1.32-2.48)
Received weight loss advice	†	†	†	1.75 (1.02-3.01)

\*Group 1 includes those meeting the goal of 5 or more servings of fruits and/or vegetables per day only; group 2, those meeting the goal of 30% or less of calories from fat per day only; group 3, those meeting both goals; and group 4, those meeting neither goal. CI = confidence interval; OR = odds ratio.

†Variable was not significant and therefore not used in the multinomial analysis.

there is substantial room for improvement, even among the most adherent subgroups of the population.

The challenge of meeting dietary guidelines for fruits, vegetables, and dietary fat in communities is formidable in this day of ultrasized fast-food marketing campaigns but not unsurpassable. Previous reports have identified several key factors that are associated with improvements in community-wide dietary habits. These factors include the use of targeted media campaigns,<sup>11</sup> straightforward advice from health care practitioners,<sup>12,13</sup> and support from community-based groups and businesses.<sup>14-17</sup> A combined effort involving support from all these resources along with the general population will clearly be needed to improve widespread, suboptimal dietary habits and their associated outcomes.

Our survey has several potential limitations. First, although our telephone survey involved a random, community-based sample of local residents, our mail-in food frequency questionnaire was returned by only 67% of the telephone survey respondents. Those who failed to respond to our mailed nutrition survey, however, were similar to those who responded, although the former were slightly younger due to a low response rate for men younger than 50 years. Although the results were weighted to adjust for differences in the response rate by sex and age, we were not able to adjust for other factors, such as dietary habits, which may have differed between responders and nonresponders. If nonresponders are less likely than respond-

ers to meet the specified dietary guidelines for fruit, vegetable, and fat intake, our results may actually overestimate the percentage of residents who meet these dietary goals. Second, the accuracy of a food frequency questionnaire, such as the one used in our survey, may be suboptimal compared with other survey tools (eg, food diaries). Food frequency questionnaires, however, perform acceptably well for measuring intake of major food groups (eg, red meat, dairy products) and are highly practical for sampling nutrition habits of large population groups.<sup>18,19</sup> The Centers for Disease Control and Prevention has used a food frequency questionnaire to monitor dietary habits in the United States for the past 2 decades.<sup>9,20</sup> Third, despite similarities to national data, as mentioned herein, our data are from one county from one point in time and thus may be unique to our local population. Fourth, our results are based on self-reported data and are therefore limited by the inherent inaccuracies of such data collection methods.

Results from our survey from Olmsted County suggest that only a few adults (16%) are meeting dietary recommendations for intake of fruits, vegetables, and fat. National data are helpful to understand national dietary trends, but local dietary intake data are critically important as local public health and medical care initiatives are planned and implemented to fit with the particular needs and concerns of local communities. Local public health campaigns (eg, CardioVision 2020) and national campaigns (eg, *Healthy People 2010*) will need to partner with local health care

practitioners and community organizations to develop effective methods to promote healthier dietary habits among all subgroups of the population.

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