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Dietary Cardiovascular Risk Factors and Serum Cholesterol in an Old Order Mennonite Community

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ABSTRACT

Objectives. Dietary and coronary heart disease risk factors in Old Order Mennonite men and women were examined.

Methods. A food frequency questionnaire was mailed to 250 Mennonites who had participated in a previous study of coronary heart disease risk factors.

Results. Mennonites consumed a diet high in total fat, saturated fats, and cholesterol. Men had lower average serum cholesterol levels (174 mg/dL) than women (191 mg/dL).

Conclusions. The Mennonites' diet was similar to that of the overall US population in saturated fat percentage and higher in cholesterol. Serum cholesterol levels, adiposity, and blood pressure were lower than expected among Mennonite men, perhaps because of their higher levels of physical activity. (*Am J Public Health.* 1998;88:1202–1205)

Introduction

Yates County, New York, is home to an Old Order Mennonite community. Established in the early 1970s, this community has grown to 144 families including more than 800 people.[1] These families possess deep religious and cultural traditions dating back to the Anabaptist movement of 16th-century Europe, a movement resulting in the Amish, Hutterite, Brethren, and Old Order Mennonite cultures.[2]

The Old Order Mennonites share a purposefully stoic lifestyle reflecting their 16th-century roots. Most community members live on small, one-family dairy farms, and large families are the norm. Within these families, the father is responsible for running the farm and managing the finances, while the mother takes care of the children and housework. Means of transportation are horse-drawn carriages, bicycles, and walking. Abstinence from alcohol and tobacco products is characteristic of the community. Children are educated through eighth grade in a church-operated one-room schoolhouse.

In a previous study,[3] this population scored poorly regarding saturated fat and cholesterol avoidance[4] relative to populations previously studied. However, their diet was not quantified. Anecdotal evidence suggests that their traditional agrarian diet includes an abundance of dairy products, eggs, and red meat.[5] We also found that, despite poor saturated fat/cholesterol avoidance behavior, Mennonite men had significantly lower serum cholesterol and blood pressure levels than their counterparts in the general US population and lower serum total cholesterol levels than Mennonite women.

The present research attempted to quantify the Old Order Mennonite diet and determine whether differences in dietary nutrient intake could explain the cardiovascular risk factor benefits unique to the male members of the study community.[6]

Methods

During interviews conducted in subjects' homes, 2 blood pressure measurements were taken with an aneroid sphygmomanometer by 2 trained interviewers, the first at 5 minutes into the session and the second at the conclusion. A nonfasting venous blood sample was collected and analyzed as described previously.[3]

All adults 16 years of age and older (n = 250) were sent the National Cancer Institute's 60-item food frequency questionnaire.[7] To more accurately capture the Mennonites' diet, we included additional food items frequently consumed, such as peas, green beans, lunch meat, and pies. Subjects were also asked

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to list names and frequencies of foods common to their diet but not included on the questionnaire. Soft drinks were substituted for the alcoholic beverages category. Questions about vitamin and mineral supplements were also included. A separate component of the questionnaire elicited responses regarding alcohol and tobacco consumption and self-reported height and weight. Nutrient information was calculated via food consumption data provided by the National Cancer Institute questionnaire system.[8] Chi-square tests were used for comparisons of proportions. Student *t* tests were used to compare means.

TABLE 1—Descriptive Characteristics of a New York State Old Order Mennonite Community, by Sex

	Men (n = 80), Mean (SD)	Women (n = 69), Mean (SD)	t^a
Age, y	31.6 (9.7)	32.2 (10.3)	–0.42
Serum cholesterol, mg/dL	174.3 (36.7)	190.8 (42.9)	–2.54*
Systolic blood pressure, mm Hg	121.6 (11.9)	115.1 (13.8)	3.04**
Diastolic blood pressure, mm Hg	75.9 (9.0)	71.4 (9.9)	2.96**
Body mass index, kg/m^2	24.4 (2.9)	25.1 (3.8)	–1.15

Note. The age range of participants was 16–84 years.
[a]Men vs women.
*$P < .05$; **$P < .01$.

Results

Of the 250 individuals who were sent questionnaires, 174 (90 men and 84 women) returned them in usable form (participation rate 69.6%). Height and weight were obtained by telephone for 49 additional individuals, resulting in a total of 223 participants (120 women and 103 men) (89.2% participation rate). Households without telephones constituted the majority of the 10.8% of nonrespondents. The present study focused on 149 participants (80 men and 69 women) for whom we had complete data regarding diet, age, height, weight, blood pressure, and serum total cholesterol.

Mean age, total serum cholesterol, blood pressure, and body mass index (weight in kilograms divided by height in meters squared) for this population are included in Table 1. On average, men had significantly lower serum cholesterol levels and higher systolic and diastolic blood pressure levels than women. None of the respondents reported consumption of alcohol or tobacco products.

Daily nutrient intake is summarized in Table 2. As expected, men consumed significantly more total calories and more total fat, protein, carbohydrates, saturated fats, and dietary cholesterol than women. In terms of diet composition, no significant differences between the sexes were detectable for percentage of calories from fat, protein, or carbohydrates. In regard to vitamins A and C, fiber, iron, calcium, and other minerals, women reported significantly lower intake than men.

Table 3 compares the average diet composition of Old Order Mennonites and results from the 1987 National Health Interview Survey, in which dietary intake was estimated via the same food frequency questionnaire. The latter consisted of a representative sample of the noninstitutionalized White US population.[7] To allow comparison of these data within similar age groups, we report here results for

TABLE 2—Average Daily Nutrient Intake of a New York State Old Order Mennonite Community, by Sex

	Men (n = 80)	Women (n = 69)	t^a
Total calories, mean (SD)	2519.4 (963.0)	1739.0 (644.1)	5.72***
Protein, g, mean (SD)	96.0 (39.1)	68.7 (29.5)	4.77***
Calories from protein, %	15.3	15.8	–1.18
Carbohydrates, g, mean (SD)	290.1 (106.7)	193.6 (72.8)	6.34***
Calories from carbohydrates, %	46.7	44.9	1.72
Total fat, g, mean (SD)	110.2 (49.2)	78.4 (32.8)	4.6***
Calories from fat, %	38.7	40.2	–1.58
Saturated fat, g, mean (SD)	39.8 (18.7)	28.9 (12.6)	4.09***
Calories from saturated fat, %, mean (SD)	13.9 (2.6)	14.8 (2.8)	–2.04*
Oleic acid, g, mean (SD)	39.5 (18.8)	28.0 (12.2)	4.35***
Calories from oleic acid, %, mean (SD)	13.8 (2.5)	14.3 (2.3)	–1.32
Linoleic acid, g, mean (SD)	16.8 (8.3)	12.1 (8.21)	3.44***
Calories from linoleic acid, %, mean (SD)	6.0 (2.0)	6.1 (2.3)	–0.28
Cholesterol, mg, mean (SD)	598.7 (339.8)	449.1 (416.1)	2.41*
Calcium, mg, mean (SD)	944.6 (384.0)	743.7 (347.3)	3.33**
Phosphorus, mg, mean (SD)	1619.0 (597.2)	1164.3 (487.1)	5.04***
Iron, mg, mean (SD)	19.6 (7.7)	12.8 (5.7)	6.10***
Sodium, mg, mean (SD)	4432.1 (1744.6)	3055.7 (1261.1)	5.44***
Potassium, mg, mean (SD)	3507.1 (1292.0)	2532.4 (1090.5)	4.93***
Vitamin A, IU, mean (SD)	11 423.0 (7053.5)	8325.5 (4956.6)	3.05**
Thiamine, mg, mean (SD)	2.00 (0.77)	1.28 (0.53)	6.54***
Riboflavin, mg, mean (SD)	2.75 (1.12)	1.88 (0.86)	5.26***
Vitamin C, mg, mean (SD)	122.6 (61.9)	95.7 (61.1)	2.65*
Niacin, mg, mean (SD)	26.8 (10.7)	17.1 (7.5)	6.37***
Fiber, g, mean (SD)	20.7 (9.0)	14.1 (6.0)	5.16***

Note. The age range of participants was 16–84 years.
[a]Men vs women.
*$P < .05$; **$P < .01$; ***$P < .001$.

Old Order Mennonites 18 to 49 years of age. Standard deviations for the US data were unavailable. Therefore, to examine statistical significance between groups, we applied the observed standard deviations for Mennonites to the US data. With this limitation in mind, it appears that Old Order Mennonites of both sexes reported higher daily intakes of total calories, fat, oleic acid, protein, carbohydrates, and cholesterol than their counterparts in the US sample. In men, the diets of Mennonites and the general US population are similar with regard to percentage of calories from total fat. In women, diets are similar for percentage of calories from protein and carbohydrates.

Table 3 presents a comparison of coronary heart disease risk factors in Old Order Mennonites and a representative US sample from the National Health and Nutrition Examination Survey (NHANES).[9,10] The age range for the former was 18 to 44 years, while that for the latter was 20 to 44 years. The age range was limited to ensure comparability with the published US data, and, as for the dietary data, Mennonite standard deviations were used as estimates of the US variance. Comparisons indicate that Old Order Mennonites of both sexes are leaner (lower body mass indexes) than US men and women in general. Old Order Mennonite men exhibit, on average, lower serum cholesterol and blood pressure levels than US men overall, while women in the 2 samples exhibit similar levels of systolic blood pressure and serum cholesterol

TABLE 3—Dietary Intake and Selected Cardiovascular Disease Risk Factors: A Comparison of Old Order Mennonite and National (US) Samples

	Men		Women	
	Mennonite Sample, Mean (SD)	US Sample, Mean	Mennonite Sample, Mean (SD)	US Sample, Mean
	Dietary intake[a]			
	(n = 77)	(n = 4456)	(n = 66)	(n = 5398)
Total calories	2737 (1283.12)	2162	1930 (1122.97)	1394
Total protein, g/d	103 (44.92)	84	74 (41.97)	56
Calories from protein, %	15 (2.44)	16	16 (3.10)	16
Total carbohydrate, g/d	315 (154.06)	224	206 (113.84)	149
Calories from carbohydrates, %	46 (6.06)	42	44 (8.03)	43
Total fat, g/d	121 (62.61)	94	91 (71.50)	61
Calories from fat, %	39 (5.31)	39	41 (6.55)	39
Saturated fat, g/d	43 (21.40)	36	34 (27.19)	23
Calories from saturated fat, %	14 (2.55)	15	15 (3.04)	14
Oleic acid, g/d	44 (24.02)	34	33 (29.06)	22
Calories from oleic acid, %	14 (2.33)	14	15 (2.96)	14
Linoleic acid, g/d	19 (12.46)	18	13 (9.75)	12
Calories from linoleic acid, %	6 (1.97)	7	6 (2.35)	8
Cholesterol, mg/d	648 (472.57)	393	480 (442.51)	253
	Cardiovascular Disease Risk Factors[b]			
	(n = 87)	(n = 12 275)	(n = 72)	(n = 14 815)
Serum cholesterol, mg/dL	177.6 (36.47)	199.3	192.7 (44.24)	194.5
Systolic blood pressure, mm Hg	121.5 (12.22)	125	113.2 (12.92)	114
Diastolic blood pressure, mm Hg	75.0 (8.74)	79	70.3 (9.96)	73
Body mass index, kg/m^2	24.8 (3.06)	26	24.7 (3.78)	26

[a]Data from Block and Subar.[7]
[b]Data from the National Health and Nutrition Examination Survey.[9,10]

and Old Order Mennonite women have lower diastolic blood pressure levels.

Discussion

Results of the present study indicate that Old Order Mennonites consume a diet at least as high in total and saturated fats and cholesterol as that of the US population in general. These results confirm and quantify previous findings showing minimal dietary saturated fat and cholesterol avoidance in Old Order Mennonite men and women.[3] Other findings of interest include lower than expected serum cholesterol among male members of this community. These men had lower serum cholesterol levels than their female counterparts and, on average, the general US population. A Mennonite male advantage over the general US male population was also observed for blood pressure. For both cholesterol and systolic blood pressure, Mennonite women were similar to US women overall. Both Old Order Mennonite men and women had higher caloric intakes and lower body mass indexes than their US counterparts in general. These findings are most likely reflective of the higher physical activity levels of Mennonites than of US men and women overall. Mennonite life is characterized by lack of modernization dictated by religious beliefs, requiring a reliance on exercise-intensive modes of farming and transportation.

Previous studies have shown lower rates of overweight[11] and serum cholesterol[12] in farm laborers than in urban dwellers, despite similarities in diet composition. More recent studies of physical activity and total serum cholesterol have been inconclusive.[13,14] Carefully controlled dietary experiments have shown that saturated fat intake increases serum cholesterol, even in situations of intense physical labor and isolation from the stress of Westernized life, but there are indications that reductions in total and low-density lipoprotein (LDL) cholesterol can be achieved through exercise, especially with accompanying weight loss.[15] High levels of activity and low body mass indexes, however, do not seem to provide any serum cholesterol or systolic blood pressure benefits among Mennonite women.

Regarding serum cholesterol levels, it has been shown that both exercise[16] and weight loss[17] have a greater influence on lowering LDL cholesterol and raising high-density lipoprotein cholesterol levels in men than in women and in older[18] or postmenopausal women[19] than in premenopausal women. Higher endogenous estrogen levels in younger women[18] may account for the lack of effect of physical activity and low body mass index on lipids in Mennonite women.

Another explanation for gender differences in serum cholesterol in this population could be the reproductive history of the women. Pregnancy-related lipid changes have been reported showing that cholesterol can rise nearly 50%[20] during pregnancy; LDL cholesterol levels have been shown to increase throughout pregnancy and to stay above prepregnancy levels for several weeks after delivery.[21] The typical multiple pregnancies of Old Order Mennonite women may have an unfavorable effect on their cholesterol levels.

Limitations of the present study include the following: (1) reliance on self-reported height and weight for the Old Order Mennonites; (2) different methodologies for serum cholesterol and blood pressure determination for Old Order Mennonites and the general US population; (3) different time periods for the US studies and the present study and the possible confounding effects of temporal trends in coronary heart disease risk factors in the US population; (4) the fact that dietary information was collected approximately 1 year after assessment of cholesterol, blood pressure, height, and weight; (5) lack of information on the variability (standard deviation) of US data; and (6) lack of a direct measurement of physical activity. However, self-reported height and weight have been shown to be highly reliable.[22,23]

Serum cholesterol was determined with tightly controlled and standardized methods.[3] For blood pressure, NHANES II used mercury sphygmomanometers, whereas the present study used aneroid sphygmomanometers. The limitations involved in comparing different studies in terms of blood pressure levels are well known. Evidence that the timing of risk factor measurements prior to dietary assessment did not affect our findings comes from the fact that participants reported poor saturated fat/cholesterol avoidance behavior in the initial study along with satisfactory risk factor measurements, including total cholesterol and blood pressure.[3] Therefore, the current dietary measurements better quantify and confirm the previously discovered poor saturated fat/cholesterol avoidance behavior.

Regarding US temporal trends, cholesterol levels are dropping,[24] while overweight and obesity are increasing. The results from phase I of NHANES III have shown a 3.3% drop in serum cholesterol since NHANES II in men 20 to 44 years of age. Taking into account this trend and differences in methods of serum cholesterol determination between the 2 studies still does not completely explain the observed differences in coronary heart disease risk factors between Old Order Mennonite men and US men in general. Gender

comparisons within the present study were not influenced by these limitations and therefore do not invalidate our findings of a better coronary heart disease risk profile in men than in women in this cloistered community. Finally, our study population represents only one community of Old Order Mennonites, and one fairly recently established. However, it appears that no significant lifestyle changes have taken place in this community. The limitations just described require cautious interpretation of comparisons between US and Mennonite data.

The apparent male-specific benefits with regard to coronary heart disease risk profile (e.g., blood pressure and serum cholesterol) observed in this Old Order Mennonite community are in agreement with findings showing that older Amish men (but not women) have lower rates of cardiovascular disease mortality than the US population in general.[6] In this culture, as in the Amish culture, men are considered to be at a higher level in the social hierarchy than women.[25] In British civil servants, social status has been shown to be inversely associated with blood pressure and coronary heart disease mortality[26] but not with serum cholesterol.[25]

In conclusion, life in this Old Order Mennonite community is characterized by intense, prolonged physical activity and a diet high in total and saturated fat, one very similar in composition to the diet of the general US population. The elevated energy expenditure and subsequent low adiposity are probably responsible for the low levels of serum cholesterol and low blood pressure evidenced in the male members of this community. This coronary heart disease risk profile advantage in men (vs the general US population) is not observed in women. The explanation for this advantage is unclear at present. Carefully designed longitudinal studies of cardiovascular risk factors and morbidity and mortality rates are needed to definitively explain apparent gender differences in coronary heart disease risk factors and mortality and assess the true risk for cardiovascular disease in this population. □

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