

# Nut consumption, vegetarian diets, ischemic heart disease risk, and all-cause mortality: evidence from epidemiologic studies<sup>1,2</sup>

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**ABSTRACT** Perhaps one of the most unexpected and novel findings in nutritional epidemiology in the past 5 y has been that nut consumption seems to protect against ischemic heart disease (IHD). Frequency and quantity of nut consumption have been documented to be higher in vegetarian than in non-vegetarian populations. Nuts also constitute an important part of other plant-based diets, such as Mediterranean and Asian diets. In a large, prospective epidemiologic study of Seventh-day Adventists in California, we found that frequency of nut consumption had a substantial and highly significant inverse association with risk of myocardial infarction and death from IHD. The Iowa Women's Health Study also documented an association between nut consumption and decreased risk of IHD. The protective effect of nuts on IHD has been found in men and women and in the elderly. Importantly, nuts have similar associations in both vegetarians and nonvegetarians. The protective effect of nut consumption on IHD is not offset by increased mortality from other causes. Moreover, frequency of nut consumption has been found to be inversely related to all-cause mortality in several population groups such as whites, blacks, and the elderly. Thus, nut consumption may not only offer protection against IHD, but also increase longevity. *Am J Clin Nutr* 1999;70(suppl):500S–3S.

**KEY WORDS** Nuts, vegetarian diets, vegetarianism, confounding, ischemic heart disease, coronary risk, IHD risk, all-cause mortality, epidemiologic studies, Adventist Health Study, Seventh-day Adventists, California

## INTRODUCTION

Perhaps one of the most unexpected and novel findings in nutritional epidemiology in the past 5 y is that nut consumption seems to protect against ischemic heart disease (IHD)—the leading cause of death in men and postmenopausal women worldwide. Most publications linking nuts to health outcomes were published after the Second International Congress on Vegetarian Nutrition in June 1992. However, the epidemiologic evidence for the protective effect of other plant food groups such as fruit, vegetables, legumes, and cereals against chronic diseases began to appear in the literature much earlier than 1992 (1–4).

Why was there this delay in investigating the effect of nuts? Nuts were not considered the most desirable food to protect against heart diseases because they are very high in fat (5). Ear-

lier studies in laboratory animals suggested an atherogenic role for peanut oil (6–8), and although some later studies contradicted the earlier finding (9), no specific hypotheses were formulated to guide further studies of nuts. More importantly, nuts were and are infrequently consumed by the general population (10), making it difficult to study them from the epidemiologic viewpoint. However, some populations such as vegetarians, Mediterraneans, and California Seventh-day Adventists consume nuts quite frequently (11, 12). Interestingly, a lower risk of IHD has been documented in all of these populations (13–17), although the impetus to study them came from lines of reasoning other than frequent nut consumption.

This article briefly reviews the topic of nut consumption in vegetarians and summarizes the epidemiologic evidence linking nuts to IHD risk and all-cause mortality in the context of vegetarianism. In an accompanying article in this supplement, I, along with Kris-Etherton et al (18), review human feeding studies on the effect of nut consumption on serum lipids and other indexes of IHD risk.

## NUT CONSUMPTION PATTERNS OF VEGETARIANS

The frequency and quantity of nut consumption has been documented to be higher in vegetarian than in nonvegetarian populations. This is not a recent or local phenomenon. In India, which has millennia of vegetarian tradition, peanuts and peanut oil are prominent parts of the diet. Most vegetarians in Western countries include nuts in their diets on a regular basis. Nuts are high in protein and fat and vegetarians tend to eat them to complement cereals and beans as staple foods. For most vegetarians, nuts are not perceived as an occasional or snack food but a food consumed consistently as part of meals.

Nuts may be an important source of energy in the diets of vegetarians. Data adapted from an earlier review of the literature on nut consumption are shown in **Table 1** (19). The daily contribution of nuts varies according to the types of vegetarian diets. Lacto-ovo vegetarians consumed 30–42 g nuts/d, whereas those

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**TABLE 1**  
Daily contribution of nuts to the diets of different types of vegetarians<sup>1</sup>

Type of diet	Amount	Energy	Total energy
	g	kcal (kJ)	%
Lactoovovegetarian	33–42	200–250 (840–1050)	6–9
Vegan	50–71	300–425 (1260–1785)	12–13
Fruitarian	88	525 (2205)	42

<sup>1</sup> Adapted from Hardinge and Crooks (19).

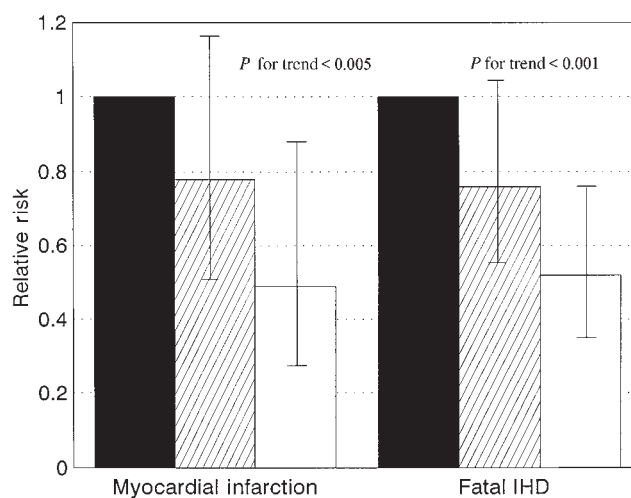
excluding all animal products on average consumed 50–71 g nuts/d. This contrasts with the low per capita consumption of nuts in the United States and other countries that follow a Western-type diet (10).

Even in health-conscious populations such as Seventh-day Adventists in California, vegetarians consume nuts more frequently than do those who include meat in their diets. The frequency of nut consumption of participants in the Adventist Health Study according to vegetarian status is presented in **Table 2** (20). For comparison, we also present data from another well-known cohort study, the Nurses' Health Study (21); these data probably represent the nut consumption patterns of the general United States population. Both cohort studies gathered data at about the same time and used very similar methodology. Thirty-one percent of vegetarian subjects in the Adventist Health Study consumed nuts  $\geq 5$  times/wk, whereas only 15% of non-vegetarians and 5% of participants in the Nurses' Health Study consumed nuts at a frequency this high. Vegetarian Seventh-day Adventists in California ate nuts more frequently than do their nonvegetarian counterparts and much more frequently than the general population.

Frequency of nut consumption may be increasing in health-oriented groups. This seems to be the case in Seventh-day Adventists in California. Data from a recent dietary questionnaire validation study on a sample of Seventh-day Adventists in California are also presented in Table 2 (22). In both vegetarian and nonvegetarian groups, the frequency of nut consumption is dramatically higher than that of 2 decades earlier. Part of this increase may be explained by different survey methods, but again, vegetarians ate nuts more often than did nonvegetarians.

### ISCHEMIC HEART DISEASE RISK

The Adventist Health Study is a prospective, epidemiologic study in 34 198 Seventh-day Adventists in California investigating the association between intake of certain foods and risk of chronic diseases (20). This cohort study was the first to report the protective effect of nuts on IHD risk and this finding was



**FIGURE 1.** Adjusted relative risk of 2 ischemic heart disease (IHD) endpoints according to frequency of nut consumption (■, <1 time/wk; ▨, 1–4 times/wk; □,  $\geq 5$  times/wk): the Adventist Health Study (20). Data adjusted simultaneously for age, sex, smoking, exercise, high blood pressure, consumption of meat, and bread type. Vertical lines indicate 95% CIs.

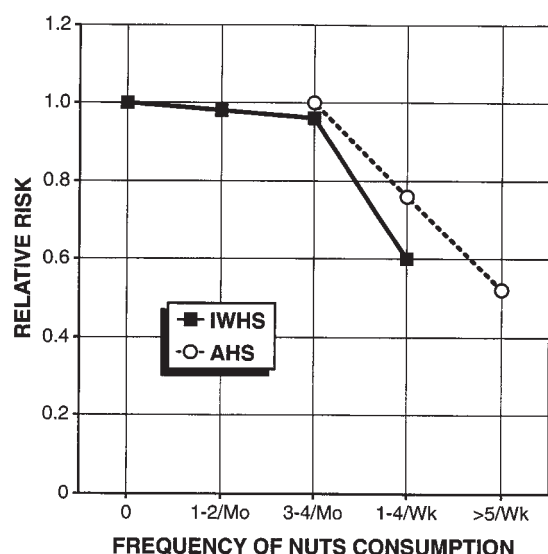
somewhat unexpected. Previous studies in Seventh-day Adventists have documented the lower risk of IHD of vegetarians compared with nonvegetarians (13, 23). Differences in consumption of meat and other foods were included in the hypotheses to be tested in the Adventist Health Study, but nuts were not in the a priori list. Nevertheless, in this epidemiologic investigation we found that frequency of nut consumption was inversely related to the risk of having an acute myocardial infarction or dying of IHD (20). This effect was independent of established IHD risk factors such as age, sex, smoking, hypertension, relative weight and exercise, and consumption of other foods such as fruit, legumes, bread, cheese, fish, meat, and coffee. The adjusted relative risk of 2 IHD endpoints in this population according to 3 categories of nut consumption are shown in **Figure 1**. Compared with the group eating nuts <1 time/wk, those who ate them 1–4 times/wk had a 22% reduced risk of acute myocardial infarction, whereas those eating nuts  $\geq 5$  times/wk experienced a 51% reduction in risk. Similar reductions in risk of death from IHD were observed. Thus, the protective effect of nut consumption was found in different clinical manifestations of IHD.

On subsequent analysis, we found that the protective effect of nut consumption on IHD was consistent in several population subgroups. Nut consumption was inversely related to the risk of

**TABLE 2**  
Frequency of nut consumption in California Seventh-day Adventists according to vegetarian status, and in a reference group<sup>1</sup>

Consumption frequency	AHS cohort (1976)		NHS cohort	AHS pilot study (1996)	
	Vegetarians	Nonvegetarians		Vegetarian	Nonvegetarian
		%	%		%
<1 time/wk	26	48	70	3	6
1–4 times/wk	44	37	24	31	40
$\geq 5$ times/wk	31	15	5	66	54

<sup>1</sup> AHS, Adventist Health Study; NHS, Nurses Health Study. Adapted from Fraser et al (20), Willett (21), and Pribiš et al (22).

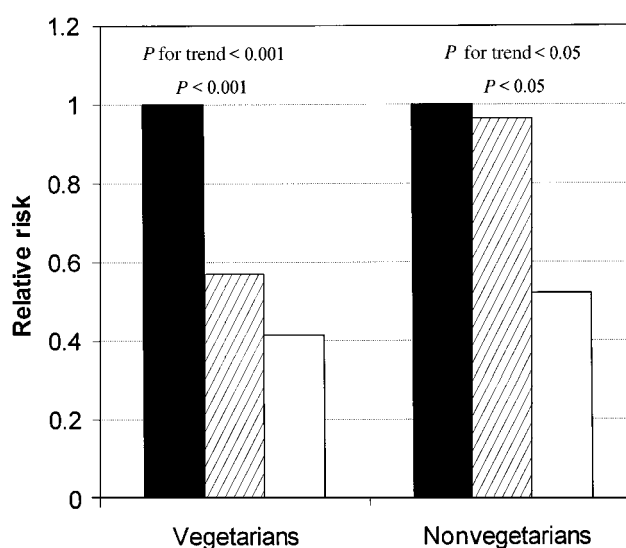


**FIGURE 2.** Relative risk of ischemic heart disease according to frequency of nut consumption in the Iowa Women's Health Study (IWHS) and the Adventist Health Study (AHS). Reprinted with permission from reference 12.

IHD in men as well as women, in younger and older subjects, in persons with normal blood pressure, and in those with high blood pressure. The same protective effect was seen in subjects regardless of their relative weight, smoking status, or physical activity level.

Further epidemiologic support for an association between nut consumption and decreased risk of IHD was recently provided by the Iowa Women's Health Study despite the fact that only a relatively small percentage of this population consumed nuts frequently, which limited the statistical power. In this cohort study of 34 500 postmenopausal women followed for 5 y, coronary mortality was inversely associated with nut intake (24). After adjustment for established IHD risk factors and energy intake, women who consumed nuts > 1 time/wk experienced a 40% reduction in IHD risk compared with those who ate nuts less frequently. Consuming nuts only a few times per month conferred no appreciable benefit for IHD reduction.

Data from the Adventist Health Study and the Iowa Women's Health Study are summarized in **Figure 2**. These cohorts have



**FIGURE 3.** Age- and sex-adjusted relative risk of definite ischemic heart disease events at 3 levels of nut consumption (■, < 1 time/wk; ▨, 1-4 times/wk; □, ≥ 5 times/wk) according to vegetarian status: the Adventist Health Study (20).

different distributions in the frequency of nut consumption and the cutoff points for the analyses were different. However, combining data in this fashion allows us to observe the effect of nuts over a wider range of intake. A threshold effect seems to exist at a consumption frequency of  $\approx 1$  time/wk. Consumption of nuts a few times per month conferred no appreciable benefit for IHD, but at a frequency of consumption of  $\geq 1$  time/wk an inverse, graded relation was clearly observed. Results from both cohort studies were remarkably consistent in these observations.

Using data from the Adventist Health Study, Fraser et al (25) developed a novel approach to assessing the lifetime risk of developing IHD and to computing age at first coronary event. Persons consuming nuts  $\geq 5$  times/wk lowered their lifetime risk of IHD by 12%, and men who developed the disease did so 5.6 y later than did men who consumed nuts infrequently. Thus, high nut consumption seems not only to decrease the lifetime risk of IHD but to postpone the development of the disease for several years.

**TABLE 3**

Frequency of nut consumption and all-cause mortality in several California Seventh-day Adventist subpopulations

Population	Follow-up period	Adjustments	Hazard ratio (95% CI) for nut consumption		
			< 1 time/wk	1-4 times/wk	≥ 5 times/wk
Whites (28) ( <i>n</i> = 31 208)	1976-1982	Age, sex, and vegetarian status	1.0	0.72	0.67 <sup>1</sup>
Blacks (29) ( <i>n</i> = 1668)	1976-1985	Age, sex, smoking, and exercise	1.0	0.60 (0.4, 0.9)	0.56 (0.3, 1.0)
Oldest-old (30) (> 84 y of age (17 446 person-years))	1976-1988	Age, sex	1.0	0.82 (0.72, 0.95)	0.75 (0.65, 0.86)
		Age, sex, diabetes, smoking, exercise, and meat, fish, fruit, bread, doughnut, and sweets consumption	1.0	0.88 (0.79, 1.01)	0.82 (0.70, 0.96)


<sup>1</sup>Significant trend,  $P < 0.001$ .

### NUT CONSUMPTION VERSUS VEGETARIAN STATUS

If vegetarians have lower risk for IHD and at the same time vegetarians consume nuts more frequently than do nonvegetarians, there is a possibility of confounding. In fact, it has been argued that the apparently beneficial effect of nuts is nothing else but the lack of a detrimental effect from meat, eggs, and dairy products, which vegetarians substitute nuts for either partially or totally (26).

Data from the Adventist Health Study relating frequency of nut consumption to IHD risk according to vegetarian status is shown in **Figure 3** (20). About 50% of subjects in the Adventist cohort were nonvegetarians. The protective effect of nuts was observed in vegetarians as well as nonvegetarians and thus cannot be explained on the basis of confounding effects. Also, multivariate analyses in the whole population with the consumption of eggs, milk (27), meat (20), and the standard IHD risk factors controlled for did not show any diminution of the protective effect of nuts on IHD risk. Although confounding with other foods is an important issue in any nutritional epidemiologic study, the infrequent intake of animal products by vegetarians does not seem to explain the protective effect of nuts in this population. The effect of nuts appears to be independent of meat and other foods studied, and more importantly, the beneficial effect is present in nonvegetarians as well.

### NUT CONSUMPTION AND ALL-CAUSE MORTALITY

Frequency of nut consumption seems to be inversely related to all-cause mortality in several population groups (28–30). The reasons for this association are not entirely understood, but we presume that they largely reflect the decrease in IHD mortality. The protective effect of nut consumption on IHD is not offset by an increased mortality from cancer (28) or competing causes (25). Published data linking nut consumption to total mortality in California Seventh-day Adventist subpopulations are summarized in **Table 3**. Frequent nut consumption was associated with lower mortality in whites, blacks, and the elderly. Depending on the degree of adjustment and the population group, total mortality rates were lower, ranging from 18% to 44% in those consuming nuts  $\geq 5$  times/wk compared with infrequent consumers. Again, the effect of nuts on all-cause mortality seems to be independent of other risk factors and the potential confounding effect of vegetarian status or meat consumption. Thus, nut consumption may not only offer protection against IHD but may also increase longevity. 

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