

**Diet, Life Expectancy,
and Chronic Disease:
Studies of Seventh-day
Adventists and Other
Vegetarians**

GARY E. FRASER

OXFORD UNIVERSITY PRESS

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To Sharon

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Preface

For nearly 140 years, Seventh-day Adventists have been encouraged to avoid meat and emphasize fruits, vegetables, and nuts in their diets. One rationale for this has been that such a diet promotes better health. There have been vegetarians, some very prominent, for thousands of years. Until the nineteenth century, however, improved health was an uncommon motivation. More typically, the driving force was animal rights or the perceived virtue of an ascetic lifestyle in certain other religious groups.

John Wesley, Sylvester Graham, William Alcott, and Russell Trall (Barkas, 1975; Numbers, 1992; Whorton, 1994) are among the American reformers who 150 to 200 years ago became convinced that a vegetarian way of life promoted health. Adventists joined this mix in 1863, and a health message continues today to be an important part of their tradition. However, most people now demand scientific evidence, rather than faith alone, as a criterion for action.

The famous Framingham Study was launched in 1948, and within 10 years an extensive study of the health of California Adventists also got under way with the aid of federal funding. By subjecting their health experiences to scientific scrutiny, Adventists in theory faced the possibility that research evidence would not support their claims. This has not been the case, although research results may suggest minor changes in the Adventist positions.

Almost by definition, a religious group gives credence to subjectivity and to claims that can be neither proved nor disproved. In studies of Adventists over the years, this interface with the supposedly objective methods of epidemiologic research has created an interesting tension. Fortunately, as a group, Adventists have placed great emphasis on education and traditional health care. They own and run many highly regarded medical centers throughout the United States and also overseas. Thus, for many

Adventists, the rigorous investigation of one tenet of their faith that could be subjected to scientific methods was intriguing—indeed, attractive.

Our studies in California have always been guided during data collection by an external committee of some of the country's leading non-Adventist epidemiologists. Published reports, as usual, are rigorously peer-reviewed before publication. Despite this, it must be acknowledged that all evidence, even the seemingly objective, is interpreted through the filter of the investigators', and now the readers', past experiences and prejudices. These are the "spectacles behind the eyes" referred to by Russell Hanson (1969) and by the eminent physicist-cleric John Polkinghorne (1993). This problem with interpretation of evidence is not at all unique to studies of Adventists. It affects most researchers as they evaluate their own cherished data and hypotheses.

Until quite recently, vegetarians were commonly regarded as a little eccentric, and in some cases this was probably justified. Health professionals were not confident that such a diet was beneficial. Indeed, serious reservations about nutritional adequacy were commonly expressed.

As far as I know, the evidence that links vegetarianism directly to health and life expectancy has not been comprehensively reviewed before. This is also true of health research among Adventists, where more than 320 publications in the peer-reviewed literature are spread over 40 years through dozens of different journals. This book is in part a response to the requests of health professionals and lay-persons to summarize this information in a more compact and accessible form.

Another motivation has been to give readers some insight into nutritional epidemiology. Many people, even health professionals, are confused by the frequently conflicting reports of the effects of diet on health status that appear in newspapers and on television screens. I have tried to provide explanations for the conflicts by describing the difficulties in this line of research and giving some guidelines for interpreting the evidence. Undoubtedly, some people will be surprised at how few conclusions we can draw with confidence. But enough is clear about the benefits of vegetarian diets, or diets that tilt in this direction, to recommend them with confidence.

The intended readership for this book is primarily health professionals, including physicians, nurses, health educators, nutritionists, and epidemiologists, who may find it a useful reference. Nonprofessionals may also find the book of interest, however, as I have made an effort to keep the language relatively nontechnical or, where technical terms are unavoidable, to explain them in a glossary. The glossary is extensive, and readers who encounter unfamiliar terms are encouraged to use it. The summaries at the

end of each chapter, and also the contents of the final chapter, will help all readers understand my interpretation of the evidence.

This book should be of interest to members of the Seventh-day Adventist Church. Many, particularly in California but also elsewhere, have spent a good deal of time filling out long dietary questionnaires without ever having had a comprehensive report on the results of their efforts. I hope that this work will fill a void for them and also will serve as a “thank you” for the time and efforts of all who participated. The evidence it presents about a long-held position of the Adventist church on dietary practice will comfort some and may encourage other, less-committed, vegetarians to reconsider.

The chapters are ordered to first report health and lifestyle comparisons between Adventists and non-Adventists living in the same areas (1–4). As it turned out that Adventists in general do better, the next chapters (5–8) address the question of which facets of the diet might at least partly explain these differences. Of course, Adventists differ from non-Adventists in ways aside from what they eat. So Chapter 9 deals (as well as we can) with the possible influence of psychosocial factors and differences in religious commitment on physical health.

Chapters 10 and 11 report the evidence about health effects from studies of non-Adventist vegetarians and other health-conscious individuals. Chapter 12 considers risk factor values in vegetarians as compared to others, and here, too, much of the information comes from non-Adventist vegetarians. Chapter 13 continues the same theme, but the focus is on the risk factor values and the health experiences of a particular type of vegetarians, the vegans, who do not eat any animal products.

Chapters 14 and 15 appear rather different from the others. Although the emphasis on a vegetarian diet is clear, these chapters have a much more practical, behavioral approach, rather than the epidemiologic approach of the rest of the book. Some readers may have an interest in changing to a vegetarian diet, and I hope these chapters will be helpful.

Loma Linda, California

G.E.F.

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Acknowledgments

First, my wife, Sharon, claims that she has missed me on the many evenings and occasional Sundays spent in preparing this book. I am extremely grateful for her willingness to overlook these indiscretions. My time in this work has been partially funded, and in particular I must recognize Loma Linda University (Dr. Lyn Behrens) and the North American Division and General Conference of Seventh-day Adventists (Drs. DeWitt Williams and Alan Handysides) for their support. The National Institutes of Health and the U.S. Public Health Service have provided many large grants to support the collection and analysis of data in California Adventists over a period of 40 years. Special thanks to DeWitt Williams who carefully reviewed most of the manuscript, pointing out many minor omissions and inconsistencies. My thanks also to colleagues who authored or coauthored three of the chapters, specifically Drs. Graham Stacey, Jerry Lee, Helen Hopp-Marshak, Kiti Freier, and Ella Haddad.

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If the money we use to purchase and eat the muscles of cows, pigs, chickens, turkeys, and fish were put into vegetables, fruits, and lipid-lowering drugs, our health would skyrocket. . . . There is still a holocaust going on—just ask the cows (100,000/day killed in the USA) or pigs (250,000/day) or chickens (15,000,000/day). The healthier are our nonhuman animals, the healthier are the human ones. We kill them, and then, they kill us!*

William C. Roberts, MD
Editor, *American Journal of Cardiology*

*Reprinted from *Am J Cardiol* 83:817, 1999. Shifting from decreasing risk to actually preventing and arresting atherosclerosis; with permission from Excerpta Medica Inc.

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Diet, Life Expectancy, and Chronic Disease

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1

Why We Study the Health of Adventists

WHO ARE SEVENTH-DAY ADVENTISTS?

Who are Seventh-day Adventists, anyway? How can their lifestyle help others become more healthy?

Seventh-day Adventists are a conservative religious group that includes more than 13 million members worldwide. They were first organized as a denomination in 1863 in the eastern United States. Their roots can be found largely in Methodism. While they share many of the doctrines of mainline Protestant churches, Adventists differ from most in their relatively strict observance of Saturday, rather than Sunday, as their day of rest. They also differ from some Protestants groups by:

- Looking forward to a soon-to-occur, literal second coming of Jesus Christ
- Believing that the dead remain in a state of unconsciousness until this event
- Traditionally emphasizing the value of biblical prophecy
- Being creationists

A key figure during the early years of the Adventist church was Ellen G. White. She was a forceful and talented speaker and, along with her husband James, a wise administrator. On numerous occasions she claimed to have received heaven-sent messages, several of which were related to lifestyle and health. These episodes would often occur during times of prayer, and they affected her profoundly, casting her into a trancelike state, sometimes for lengthy periods. She became a prolific writer (Goen, 1971), documenting her visionary experiences and also writing commentaries on most parts of the Bible.

In the same year that their church was organized (1863), the small Adventist group also began to emphasize the role of lifestyle in promoting health, happiness, and enhanced spirituality. Thus, Adventists have

strongly recommended their distinctive lifestyle for 140 years, although only the use of alcohol and tobacco, and the consumption of biblically unclean foods such as pork, are actually prohibited. In addition, the church recommends that Adventists avoid the consumption of other meats and poultry, fish, coffee, tea, other caffeine-containing beverages, rich and highly refined foods, and hot condiments and spices. The church also recommends that Adventists exercise regularly. In light of these recommendations, at least half of American Adventists today either are lacto-ovo vegetarians or eat meat less than once a week, but they follow other specific recommendations to varying degrees.

Ellen White inspired the adoption of these lifestyle recommendations. Indeed, beginning in the mid-1860s, she wrote extensively (White, 1905; White, 1938; White, 1951) in her efforts to encourage changes that she claimed would lead to better health. Her ideas were not in themselves unique, but they formed an original mix. Three of her many written statements are cited in the footnote to this chapter.¹

Other health reformers of the mid-nineteenth century and of earlier periods were also active in advocating similar changes. These included clerics such as John Wesley (founder of the Methodist church), who wrote extensively on health; the Bible Church pastor William Metcalfe, who introduced vegetarianism into the United States in an organized fashion; the Presbyterian minister Sylvester Graham (of Graham Cracker fame); and the Millerite preacher-physician Larkin B. Coles. Many religious people became concerned about the abuse of alcohol—leading to the establishment of a strong interdenominational temperance movement. The early Adventists were no exception to this movement—Ellen White and other Adventists were very active temperance reform advocates.

The Adventists' interest in health quickly led to the establishing of health-care institutions for both their own use, and to the spreading of the health message to others. This message included the arguments that appropriate lifestyle changes could prevent disease, improve the existing poor health conditions, and enhance the religious experience. Battle Creek, Michigan, became the site of the Western Health Reform Institute, the first such health institution. By 1878 the institute was succeeded by the much larger Battle Creek Medical and Surgical Sanitarium, which was directed by the dynamic young Dr. John Harvey Kellogg. Although the Battle Creek Sanitarium quickly became a world-famous institution, John Kellogg parted ways with the Adventist church around 1905 because of his disagreements with the church leaders about theology, administrative style, and, later, some of the medical methods that he advocated.

Before he left the Adventist church, Kellogg and his brother Will had already invented flake cereals and peanut butter. This soon led to the founding of the Kellogg food company, now a household name (Schwarz,

1970). Although it is not now an Adventist business, it certainly began as such, and the same motives noted above have led to the organization of several other well-known health food companies that are, or until recently have been, owned by Adventists. These companies include Loma Linda Foods, La Loma Foods, Worthington Foods in the United States; Granose Foods in the United Kingdom; and, perhaps most prominent, the Sanitarium Health Food Company in Australasia, where Weetbix, Marmite, and peanut butter are national staples. Besides producing breakfast foods, many of these companies have also specialized in plant-based protein foods and drinks, using soy, wheat gluten, and peanut proteins.

Dr. Harry Miller, an Adventist surgeon who went to China as a missionary in the early years of the twentieth century, noted the frequent use of soybeans, especially among adults, in the Far East. He also observed that severe malnutrition was common in infants, perhaps due partly to the lack of cow's milk as a protein source. By the mid-1930s, he succeeded in developing ways to make soy milk both more palatable and less likely to cause an intestinal upset due to colonic fermentation of undigested carbohydrates from the soybeans. He demonstrated soy milk's effectiveness as an infant food (Miller and Wen, 1936) and then promoted its use worldwide (Shurtleff, 1981). Thus, he became a strong advocate for the health benefits of soy 70 years ago, prefiguring the current interest of the scientific community in this food.

The Adventist church has developed a system of health-care institutions around the world. The best known of these centers is probably Loma Linda University Medical Center in California, established in 1905 by Ellen White after the Battle Creek Sanitarium was lost when John Harvey Kellogg left the church. Adventists have also been in the forefront of promoting personal health in the community and are well known for running vegetarian cooking schools and operating health-screening vans. They were among the first to develop group-based, quit-smoking programs, particularly the well-known "Five-Day Plan," which was developed by the Adventist physician J. Wayne McFarland and the clergyman-counselor Elman J. Folkenberg (Office of Cancer Communications, National Cancer Institute, 1977).

That most Adventists do follow many of the church's recommendations regarding lifestyle, and have done so for generations, is a testimony to the powerful impact of incorporating the subject of health into a system of religious beliefs. Adventists have never believed that good health practices are a measure of religious virtue, but they do see the choice of good health habits as a valuable spiritual discipline.

Others have speculated about the possible beneficial effects of religion on the changing of social norms and the promoting of adherence to healthy behaviors. Vaux (1976), for example, described the concept of "purity in

life,” which enters into Judeo-Christian belief systems. If the body and its health are considered sacred, then maintenance of health becomes a “core belief.” This will powerfully influence motivation and action. While there are few religious groups that formally incorporate health issues into their belief structure, Adventists do so, and it is a natural fit for Christianity, Judaism, or Islam. Vaux also described a second concept, “peace in existence,” arguing that “beliefs that elicit contentment and purposiveness in the life” “directly affect health attitudes and behaviors” (p. 528). It is possible that a sense of well-being and of purpose elicits a desire to “guard one’s health” and may lead to “a desire for more life, rising with a new thrill each day” (p. 530).

Finally, the knowledge and social support that are derived from belonging to a group that subscribes often to similar nontraditional values and health behaviors can be a powerful aid. It is true of Adventists that most of their friends are church members, a situation well suited to social learning, as propounded by Bandura (1977).

ADVANTAGES THAT THIS GROUP PRESENTS FOR EPIDEMIOLOGIC RESEARCH

Why are researchers interested in studying the health of Seventh-day Adventists as a group? Are they healthier than others? Have they found some special fountain of youth that so many are searching for?

Several features of this special population make them an attractive group for epidemiologic research. Such research can be plagued by both measurement problems and poor compliance when subjects are required to complete lengthy questionnaires or attend clinics. In order to test complicated dietary hypotheses, where particular foods or nutrients involve moderate-sized relative risks (say, 1.5–2.0), it is best to have several hundred new cases of disease available for the analysis. Otherwise, statistical power for detecting the effects of the risk factors is quite limited. Hence, in prospective research, the defined study population must contain a large number of subjects, typically tens of thousands, as particular chronic diseases are quite uncommon.

Obtaining baseline health-habit data from thousands of subjects is an expensive exercise, even when using a mailed questionnaire, particularly if it is necessary to send reminder letters to a large percentage of the population, or perhaps send questionnaires to twice the number who will finally respond. Adventists are by definition interested in health and have generally shown their willingness to complete lengthy questionnaires.

The accuracy of responses provided by individuals in the study is critical to both statistical power and the avoidance of bias. Random errors in questionnaire responses will most commonly bias relative risks toward the appearance of no effect and thereby diminish the chances of detecting any actual effects. Therefore, the accuracy of data improves the efficiency of such studies. Adventists are generally well educated and, because of their special interest in diet and their own dietary habits, are able to report relatively accurately about what they eat.

Many have the idea that members of such a group are relatively alike in their habits, and in some respects this is the case. For instance, the church requires abstinence from tobacco and alcohol. There is almost uniform adherence to the former, and although some alcohol is consumed, this was found to be so in fewer than 10 percent of those involved in our studies—and even these generally drink only small quantities of alcohol. Only 1.8% admitted any use of tobacco, and 4% cited the consumption of pork. Consequently, it is certainly true that the unique health experience enjoyed by Adventists as a group is partially related to the relative absence of tobacco and alcohol among them. This means that it is not possible to investigate the independent contributions of these two factors by studies within the population because virtually all abstain. There is indeed no useful comparison group! However, when testing theories relating to diet, exercise, and psychosocial and other variables, the relatively uniform absence of use of tobacco and alcohol means that investigators do not need to be concerned that subgroup differences in the use of alcohol or tobacco may distort estimates of effect.

Perhaps most important in making Adventists a fertile ground for study is the great variety found in their practice of certain key behaviors. When it comes to questions of diet, exercise, and psychosocial factors, uniformity in the group is certainly not found. Regarding diet, in particular, Adventists are quite dissimilar. The church only recommends abstinence from flesh foods and allows the eating of eggs and dairy products with no restrictions. Consequently, only about 3% of the Adventists in our studies are vegans; about 27% are lacto-ovo vegetarians; about 20% eat meat less than once each week; and the remainder, on average, eat meat more than four times each week.

Vegetables, nuts, and fruits are, on average, eaten in greater quantities than the usual amounts, but sizable subgroups still eat very small amounts of these foods. Therefore, within the group there is also a wider-than-usual range of exposures to these foods. This is an important aid to the efficiency and statistical power of research studies, particularly where measurement errors are a problem (White et al., 1994). If a food does have an effect, the opportunity then exists to demonstrate this: subgroups that eat very

large amounts of the food can be compared with others who eat it rarely or not at all. For example, our findings on nut consumption and heart disease (see Chapter 5) would hardly have been possible had it not been for the extraordinary finding that 24% of Adventists eat nuts five or more times each week, but the 34% who eat nuts less than once each week were also necessary as a sizable comparison group.

TWO TYPES OF PROSPECTIVE STUDIES USED IN THIS RESEARCH

Two different kinds of studies, both prospective in nature, have often been used to investigate the health of Adventists. These studies allow different ideas to be examined and should be interpreted with a clear understanding of their strengths and limitations.

The first type of study gathers data that allow a comparison of rates of disease among Adventists, as a group, with those from the general population in the same location. This type of study has an advantage in that the factor of interest, that is being an Adventist, is easily and accurately defined and measured. If disease rates, for instance, are lower among the Adventists than among the non-Adventists, one can reasonably conclude that there is something about the Adventist lifestyle—whether it be the absence of smoking, vegetarianism, other dietary differences, or psychosocial or religious factors—that prevents disease. Some have even suggested that genetic differences may be involved, though there is no evidence to support this idea or much reason to suspect it.

The weakness of this kind of data lies in the temptation to overinterpret the evidence obtained. These studies do not allow for the isolation of specific, potential causal factors, and indeed it is usually difficult to even know all of the factors that may provide differences between Adventists and others. Most of the older, and often smaller, studies were of this sort. They were valuable because they clearly indicated that there was something interesting here. However, more careful and detailed work is necessary to allow more specific conclusions.

Adventism is a way of life, almost a subculture. If Adventists live longer, or experience less frequent chronic disease, a natural question is, Which of the Adventists' lifestyle characteristics are responsible for this? It would be unreasonable to suggest that all aspects of the Adventist lifestyle are helpful, or at least equally helpful. To answer this question, it is useful to compare the health experience of Adventists who have different health habits. There are less likely to be important unmeasured and unthought-of differences among different Adventists than there would be in a com-

parison with an external population. Hence, confounding or confusion among different variables is reduced in this second type of study.

The second type of study is a comparison that is done within the Adventist group rather than with an external population. This immediately implies the need to measure specific lifestyle attributes of individuals. The need to measure, for example, dietary intake (foods and nutrients), exercise, obesity, and medical history is both a strength and a weakness of this type of study. It is a strength because we can potentially define some of the detailed characteristics of Adventist individuals that may explain the differences observed in the first type of study.

However, this specificity of measurement in the second type of study is also a weakness, because unlike the ability to accurately measure the label “Adventism,” the ability to accurately measure such complicated behaviors as diet and physical activity is limited. Then the whole problem of the effects of measurement errors on the analysis needs discussion. This is a very important question in the context of these studies, and in the author’s view, the fact that most of the published literature on diet and disease has ignored this difficulty has led to much confusion among lay and professional persons alike regarding the relationship between diet and health. A more detailed discussion of the possible effects of measurement errors is found in Chapter 5 and elsewhere (Thomas et al., 1993).

Another problem with the second type of study is that by comparing Adventists with other Adventists, we will inevitably restrict the available range of values of some variables. These are variables that measure habits that Adventists subscribe to in a more uniform way. For instance, we find that a very small proportion of Adventists smoke, drink alcohol, or eat red meat several times each day. Thus, we cannot accurately evaluate the effects of these levels of such habits. Yet, individuals who smoke, drink alcohol, or eat meat very frequently are not rare in the general population and will in part be responsible for the differences that we observe between Adventists and non-Adventists in the first type of study.

In summary, the first type of study leads to a general conclusion that something about these people is causing a difference in health experience. The Adventist Mortality Study (AMS) (see the Appendix) is an example of such a design—analyses compared rates of disease among California Adventists with those of non-Adventists in the concurrent American Cancer Society (ACS) Study. The second type of study attempts to isolate individual factors and examine their effects in increasing or decreasing risk. An example is the analysis based on Adventist Health Study (AHS) data. However, measurement errors are a potential problem in this type of analysis and will often (but not always) lead to an underestimate of effects.

HEALTH PRACTICES OF ADVENTISTS: THE DATA

It is one thing to recommend a particular way of life but another to get people to follow the recommendation. Physicians are well acquainted with the difficulties they have in successfully encouraging patients to exercise regularly or eat more healthfully. Before examining the health of Adventists, we must understand the nature of their health habits as actually practiced. That the church makes a recommendation may or may not result in close adherence to it. Hence, it is useful to examine the results of surveys that have sought to gather objective information.

The supposed objectivity of such survey information does indeed deserve further consideration. Most of the detailed studies of Adventists have been conducted at Loma Linda University, an Adventist institution. Hence, it is possible that Adventists may feel some pressure to appear to conform with church standards when responding to surveys. It is almost impossible to rule out some minor effects of this sort, but important biases are unlikely.

First, regarding most foods, the church only makes recommendations. It is widely understood among members that adherence is voluntary and that there are variations in commitment to these matters. Hence, with the exception of items such as the use of alcohol, pork, and tobacco, there are no external consequences of poor compliance.

Second, in the surveys at Loma Linda, we have clearly notified subjects of our commitment to confidentiality, and we have had no lapses in the security of our data. Individuals' names are never entered into computer files that are connected to their lifestyle data, and only one or two senior investigators have the knowledge that would link a name to an identifying number on the computer file.

Third, the frequency of missing data in the Adventist Health Study data set is no greater for sensitive questions than for other items having no sensitivity to religion. In addition, there is no greater degree of nonresponsiveness in regard to these sensitive items among Adventists as compared to non-Adventist members of Adventist households. In keeping with this, a small proportion of Adventists admitted the use of alcohol (8.9%), tobacco (1.8%), and pork (4%).

In this chapter, we describe the way in which California Adventists actually live by noting the proportions of them that fall into particular categories of behavior. The focus here is on diet, exercise, and psychosocial factors. The effects that these variables may have on important intermediary risk indicators, such as levels of blood pressure and blood lipids, and also the direct effect on the risk of disease, will be described in later chapters.

Since the interest in studies of Adventists relates in large part to their diet, we must understand how Adventists with different dietary patterns differ in other ways. Vegetarian status is an indicator of many other differences, and unless one carefully analyzes and interprets the data, it will not be clear whether it is the vegetarian status or the other associated variables that truly affect risk of cancer, heart disease, or early death. Therefore, we must also compare vegetarian and nonvegetarian Adventists in regard to their consumption of nonmeat foods, physical activity, obesity, education, age, and gender.

The Heart Attack Risk Factor Study

To illustrate the habits of Adventists who have been involved in our research, this book draws on two sets of data: the Heart Attack Risk Factor (HARF) Study (Fraser et al., 1987), and the Adventist Health Study (Beeson et al., 1989). The Adventist Health Study is a prospective investigation of 34,000 California Adventists, and its design is described in detail in the Appendix.

The objective of the HARF Study was to compare health behaviors and coronary risk factors between a representative group of Adventist men and their non-Adventist neighbors. In 1982, we randomly selected 13 of the 127 Adventist congregations in Orange and Los Angeles counties. From these selected churches, all non-Hispanic white males aged 35 to 55 years were invited to participate, and 90% (160 men) did so by completing a questionnaire and providing a blood specimen. A middle-aged non-Adventist male neighbor (living at least six doors away from the Adventist) was matched by age to each Adventist participant.

The value of this study design is, first, that most of the eligible Adventists were included—thus giving little opportunity for the bias often found in descriptive studies with a large percentage of volunteers. Second, the comparison with neighborhood men was not affected by differences in socioeconomic status, as the neighborhood matching very adequately ensured comparability according to education and income.

The Diet of Adventists

Dietary habits can be described in two main ways: either in terms of the foods that we choose to eat, or by the total nutrients and chemicals that the foods contain. Of course, particular nutrients may be common to many foods. Information from the use of both methods is presented next. It should always be remembered that since the chemical constituents of foods

Table 1–1. Mean (Standard Deviation in Parentheses) Daily Intake of Common Foods in Middle-aged Adventist Men and Their Neighbors (157 Pairs): The Heart Attack Risk Factor Study

| Food | Unit | Adventists | Neighbors | <i>p</i> Value |
|--------------------|---------------|---------------|-------------|----------------|
| Cream | Tablespoon | 0.18 (0.69) | 0.31 (1.08) | <.10 |
| Coffee | Cup | 1.20 (1.77) | 3.30 (2.98) | <.0005 |
| Alcohol | Drink | 0.008 (0.29) | 1.93 (2.88) | <.001 |
| Green salads | 3/4 cup | 0.89 (0.86) | 0.62 (0.58) | <.001 |
| Citrus fruits | Medium | 0.45 (0.53) | 0.27 (0.44) | <.03 |
| Bananas | Medium | 0.43 (0.51) | 0.21 (0.30) | <.0001 |
| Melons | Medium | 0.13 (0.29) | 0.13 (0.35) | NS |
| Other fresh fruits | Medium | 0.67 (0.83) | 0.36 (0.70) | <.005 |
| Canned fruits | 1/2 cup | 0.23 (0.34) | 0.09 (0.23) | <.002 |
| Raisins/dates | 2 tablespoons | 0.28 (0.48) | 0.11 (0.41) | <.001 |
| Other dried fruit | 2 tablespoons | 0.07 (0.24) | 0.02 (0.07) | <.02 |
| Total fruit | Medium | 2.68 (1.98) | 1.47 (1.57) | <.0001 |
| Tomatoes | Medium | 0.37 (0.40) | 0.22 (0.25) | <.0001 |
| White bread | 1 slice | 0.44 (1.01) | 0.99 (1.47) | <.0005 |
| Whole wheat bread | 1 slice | 1.61 (1.67) | 0.99 (1.24) | <.0005 |
| Butter | 1 pat | 0.37 (0.91) | 0.78 (1.21) | <.005 |
| Margarine | 1 pat | 1.26 (1.38) | 0.88 (1.10) | <.005 |
| Eggs | 1 egg | 0.50 (0.57) | 0.59 (0.56) | NS |
| Beef | 3 oz | 0.40 (0.51) | 0.75 (0.70) | <.0005 |
| Pork | 3 oz | 0.002 (0.014) | 0.14 (0.22) | <.0005 |
| Chicken | 3 oz | 0.22 (0.38) | 0.34 (0.37) | <.005 |
| Fish | 3 oz | 0.12 (0.17) | 0.21 (0.34) | <.005 |
| Meat analogues | 3 oz | 0.28 (0.43) | 0.03 (0.15) | <.0005 |

NS, nonsignificant.

are only partially understood, foods may show effects on health that are not predicted by their known constituents. The difficulties of making accurate dietary measurements are well described (Willett, 1998a), but the data shown in Tables 1–1 to 1–6 minimize the random errors from individual dietary recalls by using average levels to represent large groups of subjects.

By studying the daily intake of a variety of foods by the Adventist men and neighbors (see Table 1–1) enrolled in the Heart Attack Risk Factor Study, we immediately find differences between the two groups. Data showed that Adventists consumed less meat, alcohol, cream, coffee, butter, and white bread, and more fruit, green salads, whole wheat bread, margarine, and meat analogues. When converted to nutrients (see Table 1–2), differences are more modest, though still evident. The Adventist diet is marked by an intake of about 300 fewer calories and about 16% fewer fat calories. In this study this is due largely to the consumption of less saturated and monounsaturated fat, resulting in a higher polyunsaturated/saturated fat (P/S) ratio. Dietary cholesterol was also lower by 25%, which,

Table 1–2. Daily Mean (Standard Deviation in Parentheses) Macronutrient Intake Comparing Adventists with Their Neighbors (157 Pairs): The Heart Attack Risk Factor Study

| Nutrient (unit) | Adventists | Neighbors | <i>p</i> Value |
|------------------------|--------------|---------------|----------------|
| Calories | 2255 (781.0) | 2547 (1128.6) | <.01 |
| Carbohydrate (g) | 267 (105.8) | 243 (111.2) | NS |
| Fat (g) | 101 (45.8) | 119 (59.8) | <.005 |
| Protein (g) | 80 (30.4) | 87 (43.2) | <.06 |
| Crude fiber (g) | 6.9 (3.3) | 4.4 (2.3) | <.001 |
| Saturated fat (g) | 23.5 (11.5) | 29.0 (14.8) | <.001 |
| Linoleic acid (g) | 24.4 (13.4) | 24.0 (14.9) | NS |
| Oleic acid (g) | 33.8 (15.9) | 42.5 (21.9) | <.001 |
| Cholesterol (mg) | 312 (188.7) | 419 (242.9) | <.001 |
| P/S ratio ^a | 1.09 (0.42) | 0.88 (0.37) | <.001 |
| Keys' dietary score | 192.8 (8.97) | 198.4 (8.86) | <.001 |

NS, nonsignificant.

^aRatio of polyunsaturated to saturated fats, often used as a summary measure of the type of fat in the diet.

Source: Fraser GE et al., IHD risk factors in middle-aged Seventh-day Adventist men and their neighbors, *Am J Epidemiol* 126:638–646, 1987, by permission of Oxford University Press.

along with the higher P/S ratio, led to a significantly lower Keys score (Jacobs et al., 1979)—which predicts the effects of diet on blood cholesterol levels. Crude fiber intake was 57% greater in Adventist men.

Thus church recommendations and traditions, although only partially followed, have resulted in markedly different food choices but a more modest difference in the intake of nutrients when Adventists are compared with non-Adventists. Generally, the dietary choices of Adventists reflect more healthful habits.

Another look at the dietary habits among a larger population of Adventists, this time both men and women, was provided by the Adventist Health Study. Dietary information was gathered via a food frequency questionnaire distributed to 34,192 non-Hispanic white subjects, and also from 147 subjects in a Special Nutrition Substudy (see the Appendix). In the Special Nutrition Substudy, we developed indices of nutrient intake by comparing food frequency data with the more accurate average of five 24-hour recalls provided by these individuals. The indices were then used to convert the food frequency information to estimates of nutrient intake for the whole cohort. As there is no non-Adventist comparison group in this study, these data are used to depict differences among the dietary habits of Adventists. Particularly interesting is a comparison of other characteristics of those Adventists who reported different frequencies of meat consumption. These different frequency categories are labeled vegetarian, al-

most vegetarian (or semivegetarian), and nonvegetarian, and are defined as follows:

Vegetarian: no meat, fish, or poultry consumption

Almost vegetarian or semivegetarian: frequency of meat, fish, and poultry intake combined is less than weekly

Nonvegetarian: consumption of some meat at least once each week

Among non-Hispanic white Adventists, 29% were vegetarian, 21.3% were semivegetarian, and 49.2% were nonvegetarian. Although the categories are defined by meat consumption, there are probably many other differences between these groups, and it may be these, rather than the meat intake, that determine a different disease experience. First, there is the question of whether such powerful health predictors as Adventists' age, sex, and education define their meat consumption. Second, we evaluate whether other dietary characteristics differ among those who fall into different vegetarian categories.

Whether vegetarian Adventists are likely to be older or younger than others is addressed in Table 1-3. When interpreting Tables 1-3 and 1-4, it is useful to know that a value of 1.0 is given when the proportion of Adventists in that age group (or in the educational groups shown in Table 1-4) is neither higher nor lower than the overall average in that category of meat consumption. In fact, it can be seen that younger subjects are nonvegetarians about 18% to 20% more often than expected, whereas Adventists aged 80 years and older are about 36% more likely to be vegetarians than expected.

Whether vegetarian Adventists are on average more or less educated than other Adventists is shown in Table 1-4. Those who did not graduate from high school are 16% less likely to be vegetarians than the average, whereas college graduates are more than 31% more likely to be vegetarians than expected.

Similar analyses show that women are modestly more likely to be vegetarians than men, as men are overrepresented by 10% in the nonvegetarian category ($p < .0001$) when data are adjusted for age (detailed data are not shown). Exercise habits were also associated with the vegetarian dietary pattern ($p < .0001$), but only to a small degree. When data are ad-

Table 1-3. Association of Vegetarian Status with Age^a: The Adventist Health Study

| Age (years) | Vegetarian | Almost Vegetarian | Nonvegetarian |
|-------------|------------|-------------------|---------------|
| 25-44 | .90 | .94 | 1.18 |
| 45-64 | .88 | .95 | 1.20 |
| 65-79 | .93 | 1.10 | .98 |
| 80+ | 1.36 | 1.02 | .72 |

^aAdjusted for gender; $p < .0001$.

Table 1-4. Association of Vegetarian Status with Education:^a The Adventist Health Study

| Education | Vegetarian | Almost Vegetarian | Nonvegetarian |
|--|------------|-------------------|---------------|
| Less than high school | .84 | 1.01 | 1.19 |
| High school graduate or some college | .91 | .98 | 1.12 |
| College graduate or postgraduate degree | 1.31 | 1.01 | .75 |

^aAdjusted for age and gender, $p < .0001$.

justed for age and gender, those who exercised vigorously at least three times weekly were more likely to be vegetarians than expected, by about 7%.

The age differences in the proportions who are vegetarians and those who are not may represent a generational effect, or it could be that as Adventists age, they become more concerned about health and more conservative in their choices. Our data cannot distinguish between these two possibilities. Better-educated persons in other populations also tend to choose vegetarianism (Fraser et al., 2000), and this may reflect their better understanding of the health and ecologic consequences of their choices, or even a greater willingness to explore new foods.

It is likely that vegetarians eat differently than nonvegetarians in ways that are separate from their lack of meat consumption. As might be expected (see Table 1-5), the nonvegetarians in our study ate considerably more meat than the “almost vegetarians,” and most of this meat was beef. This is surprising since red meats are generally considered less healthy than fish or chicken, and it may indicate that among nonvegetarian Adventist subjects health is not the main motivation for their choices. Vegetarian Adventists also eat more fruit and vegetables such as tomatoes, legumes, and nuts, but they eat eggs and doughnuts and drink coffee less frequently. Vegetarians are more likely to use margarine than butter on bread, are more likely to choose whole-grain bread than white bread, and are much less likely to consume any alcohol. They also ate commercial, plant-based protein foods (meat analogues) more frequently, no doubt in part as alternatives for meat.

Differences in food intake according to vegetarian status also cause some differences in nutrient intake among the three groups (see Table 1-6). Many of these differences are small, but the values for vegetarians usually show a pattern thought to be more healthful. The P/S ratio is substantially lower in nonvegetarians, and the dietary cholesterol is greater, although cholesterol intakes in all Adventist groups are relatively low. The trends expected in the intake of vegetable or animal sources of both fat and protein are indeed seen. Dietary calcium is modestly greater in the vegetarians, which is interesting as concerns are often expressed regarding the ad-

Table 1-5. Comparison of Intake of Common Foods between Vegetarian and Nonvegetarian Adventists^a: The Adventist Health Study

| | <i>Vegetarian</i> | <i>Almost Vegetarian</i> | <i>Nonvegetarian</i> | | |
|------------------------------|-------------------|------------------------------|----------------------|----------------|---------------------------------|
| | White Subjects | | | White Subjects | All Black Subjects ^b |
| Percentage of the population | 32.0 | 22.8 | 45.2 | 100 | 100 |
| SERVINGS PER WEEK | | | | | |
| Fruits | | | | | |
| Canned | 3.17 | 2.78 | 2.30 | 2.69 | 1.85 |
| Dried | 3.13 | 2.56 | 1.81 | 2.40 | 2.19 |
| Citrus | 2.92 | 2.65 | 2.50 | 2.67 | 3.33 |
| Winter | 5.64 | 5.07 | 4.55 | 5.02 | 4.47 |
| Other | 4.26 | 3.97 | 3.57 | 3.88 | 3.98 |
| All fruit | 19.12 | 17.03 | 14.73 | 16.66 | 15.82 |
| Tomatoes | 3.77 | 3.65 | 3.54 | 3.64 | 3.15 |
| Legumes | 2.30 | 1.87 | 1.23 | 1.72 | 1.67 |
| Nuts | 3.89 | 3.26 | 2.19 | 2.98 | 2.49 |
| Green salads | 4.72 | 4.67 | 4.72 | 4.71 | 4.07 |
| Soft margarine on bread | 6.19 | 6.22 | 5.96 | 6.09 | 4.49 |
| Eggs | 1.25 | 1.64 | 2.17 | 1.75 | 1.77 |
| Doughnuts | 0.38 | 0.51 | 0.89 | 0.64 | 0.74 |
| Coffee | 0.34 | 1.39 | 5.10 | 2.73 | 0.74 |
| Beef | 0 | 0.20 | 3.05 | 1.42 | 1.94 |
| Poultry | 0 | 0.09 | 0.72 | 0.35 | 0.71 |
| Fish | 0 | 0.10 | 0.61 | 0.30 | 0.46 |
| Meat analogues | 3.48 | 3.05 | 1.35 | 2.42 | 3.08 |
| PERCENTAGES | | | | | |
| Prefers whole grain bread | 96.7 | 94.5 | 82.5 | 89.7 | 87.4 |
| Some beer or wine | 0.5 | 1.5 | 11.3 | 5.6 | 5.6 |
| Some hard liquor | 0.3 | 0.5 | 5.8 | 3.0 | 4.5 |

^aAdjusted for age and gender, non-Adventists excluded.

^bNot divided into vegetarian categories due to smaller numbers and a much lower response rate that may make these data less representative of all black Adventists.

Table 1–6. Comparison of Average Daily Nutrient Intake between Vegetarian and Nonvegetarian Non-Hispanic White Adventists:^a The Adventist Health Study

| | Vegetarian | Almost Vegetarian | Nonvegetarian |
|-----------------------------|------------|-------------------|---------------|
| Energy (kcal) | 2064 | 2053 | 2031 |
| Total fat (g) | 83.5 | 83.7 | 85.2 |
| Polyunsaturated fat (g) | 21.4 | 20.8 | 19.3 |
| Monounsaturated fat (g) | 28.2 | 28.3 | 29.7 |
| Saturated fat (g) | 23.3 | 24.0 | 28.8 |
| P/S ratio | 0.92 | 0.87 | 0.67 |
| Keys' score (mg/DL) | 188.5 | 190.2 | 198.5 |
| Vegetable fat (g) | 57.5 | 55.5 | 48.0 |
| Animal fat (g) | 22.8 | 24.4 | 32.0 |
| Cholesterol (mg) | 193.6 | 211.6 | 271.9 |
| Protein (g) | 69.3 | 69.9 | 71.7 |
| Vegetable protein (g) | 38.9 | 36.8 | 32.6 |
| Animal protein (g) | 30.3 | 31.4 | 36.4 |
| Fiber (g) | 8.57 | 8.02 | 7.07 |
| Calcium (mg) | 1010 | 1019 | 992 |
| Magnesium (mg) | 384 | 374 | 350 |
| Vitamin E ^b (mg) | 9.28 | 8.89 | 7.66 |

^aAdjusted for age and gender.

^bFrom foods alone, supplements excluded.

equacy of calcium intake by vegetarians. Intake of vitamin E, an antioxidant vitamin that may afford some protection against cardiovascular disease, is also higher in the vegetarians.

There is very little published information about the dietary or exercise habits of black Americans and their effects on the group's mortality. The Adventist Health Study included 1739 black subjects who gave dietary information (Fraser et al., 1997b). It is interesting to compare the dietary habits of black and white Adventists (see Table 1–5). In many respects, these two ethnic groups of Adventists have quite similar dietary patterns. In fact, the black Adventists typically eat fruit, vegetables, and nuts a little less frequently than the whites and drink much less coffee. However, they eat meats about 50% more frequently and, somewhat unexpectedly (given their higher meat intake), also eat meat analogues more frequently than do white Adventists.

Measuring Physical Activity

As is true for diet, it is very difficult to measure physical activity with precision, given that individuals are almost always involved in some degree of movement, and the range of different types of activity is very large and hard to quantify in surveys. Consequently, one should at least use the same questions to evaluate exercise habits when making comparisons between different people. This was possible in the HARF Study (Fraser et al., 1987),

and Adventist men reported a greater number of “sweaty exercise” sessions each week (about 50% more) than their non-Adventist neighbors of similar ages. They also had a significantly lower resting heart rate, which may indicate a greater degree of physical fitness consequent on the exercise. Another evaluation of exercise habits—this one done among 1028 black Adventists living in southern states (Murphy et al., 1997)—found that 46% participated in physical exercise three or more times per week; 26%, one time to two times per week; and 26%, less than once per week.

Selected Psychosocial Characteristics

Studies of psychosocial variables among populations that include both Adventists and non-Adventists are very few in number and limited in scope. Various psychosocial variables are suspected of affecting risk of chronic disease (Brezinka and Kittel, 1986; Eysenck, 1992), and prominent among them are those indicating higher or lower levels of social support.

Social support, resulting from supportive interactions with others, has been thought of as an antidote to stress. It is often measured in terms of whether or not a subject is married and whether the person maintains an active church affiliation or active membership in clubs or social societies. A distinction can be made between the size of a social network and the subjects’ perception of the level of support actually obtained.

Some interesting differences between Adventists and their neighbors were shown by the HARS Study (Fraser et al., 1997a). The questionnaire included a section on social support networks and revealed certain perceptions about the emotional consequences of these networks. Adventists were more likely to be currently married (see Table 1–7), but the average number of children did not differ between the two groups.

Although the Adventists had a greater number of trusted relatives and perhaps close friends (see Table 1–8), the frequency of contacts with chil-

Table 1–7. Marital Status (Percentages) for Adventist Males and Their Neighbors (157 Pairs), Aged 35–55 Years: The Heart Attack Risk Factor Study

| Marital Status | Adventists | Neighbors | <i>p</i> Value |
|----------------|------------|-----------|----------------|
| Ever married | 98.1 | 96.3 | NS |
| Present status | | | <i>p</i> < .05 |
| Married | 91.2 | 80 | |
| Separated | 1.3 | 4.4 | |
| Divorced | 5.6 | 10.6 | |
| Widowed | 0 | 1.3 | |
| Never married | 1.9 | 3.7 | |

NS, nonsignificant.

Source: Fraser GE et al., Selected social support variables in middle-aged Seventh-day Adventist men and their neighbors, *J Religion Health* 36:231–239, 1997, by permission.

Table 1–8. Average Number of Children, Trusted Friends, and Relatives per Person, and Satisfaction with Contacts, Adventist Males and Their Neighbors (157 Pairs): The Heart Attack Risk Factor Study

| | Adventists | Neighbors | <i>p</i> Value |
|--------------------------------|------------|-----------|----------------|
| No. of children | 2.6 | 2.4 | NS |
| Contact with children | | | <.10 |
| Very satisfied | 91 | 89 | |
| Somewhat satisfied | 55 | 49 | |
| Not very satisfied | 8 | 15 | |
| Not at all satisfied | 3 | 4 | |
| No. of trusted relatives | 4.0 | 3.1 | <.005 |
| Contact with trusted relatives | | | NS |
| Very satisfied | 69 | 70 | |
| Somewhat satisfied | 66 | 65 | |
| Not very satisfied | 20 | 19 | |
| Not at all satisfied | 2 | 3 | |
| No. of close friends | 4.7 | 4.1 | <.10 |
| Contact with close friends | | | NS |
| Very satisfied | 80 | 77 | |
| Somewhat satisfied | 62 | 65 | |
| Not very satisfied | 11 | 11 | |
| Not at all satisfied | 3 | 4 | |

NS, nonsignificant.

Source: Fraser GE et al., Selected social support variables in middle-aged Seventh-day Adventist men and their neighbors, *J Religion Health* 36:231–239, 1997, by permission.

dren, trusted relatives, and close friends did not differ (data are not shown), and there was no apparent difference revealed in the degree of satisfaction with the frequency of these contacts.

No clear differences between Adventists and their neighbors were revealed in the frequency of feeling lonely, but a substantially greater proportion of Adventists felt that “people really cared for them” (see Table 1–9). It is not surprising that Adventists also attend church much more

Table 1–9. Frequency of Feeling Cared For and Feeling Lonely: Adventist Males and Their Neighbors (156 Pairs): The Heart Attack Risk Factor Study

| | <i>How Often Do You Feel that Other People Really Care for You? (p < .001)</i> | | <i>How Often Do You Feel Lonely? (NS)</i> | |
|--------------|---|-----------|---|-----------|
| | Adventists | Neighbors | Adventists | Neighbors |
| Frequently | 117 | 81 | 4 | 12 |
| Occasionally | 32 | 60 | 47 | 54 |
| Rarely | 7 | 12 | 70 | 61 |
| Never | 0 | 3 | 35 | 29 |

NS, nonsignificant.

Source: Fraser GE et al., Selected social support variables in middle-aged Seventh-day Adventist men and their neighbors, *J Religion Health* 36:231–239, 1997, by permission.

frequently, with 84% attending each week as compared to only 30% of their neighbors. However, no significant difference was revealed in membership in other social groups/organizations.

SUMMARY

1. Seventh-day Adventists have a long and distinguished international history of promoting better health habits among their members and also in the wider community.
2. California Adventists have a lifestyle that is distinct from other Californians. A majority of the Adventists adhere to behaviors that may sometimes fall short of the church's recommendations but that still represent a substantial departure from those of other Californians. Many Adventists are vegetarians who eat more fruit and vegetables than others but fewer non-meat animal products.
3. Several studies have compared the disease experience of Adventists with that of non-Adventists in the same communities. (See the Appendix for study designs.)
4. More detailed information is provided by studies, done within the Adventist group, that compare members who subscribe to different habits. However, this strength is offset by the problem of measurement errors that occur when we attempt to measure the details of complex behaviors such as dietary intake and physical activity and their effects on health.
5. Adventist middle-aged men exercise more frequently than their neighbors, on average. In addition, they have a somewhat larger network of social support by being more involved in an organization with a significant social function (their church), are more likely to benefit from the support of a spouse, have more trusted relatives, and are more likely to feel cared for by others.
6. As compared to nonvegetarian Adventists, the vegetarians are on average older and better educated. In addition to the absence of meat consumption, they have other dietary characteristics closer to those recommended by the American Heart Association (Nutrition Committee, AHA, 2000), by the World Cancer Research Fund, and by the American Institute for Cancer Research (Potter, 1997). Consequently, analyses related to vegetarian status will need careful interpretation or adjustment for the effects of other factors. Otherwise, it will not be clear whether the causal factor in disease experience is the absence of meat or other factors that also characterize the vegetarian Adventists.

NOTES

1. "Foods should be prepared with simplicity, yet with a nicety which will invite the appetite. You should keep grease out of your food. It defiles any preparation of food you may make. Eat largely of fruits and vegetables" (White, 1868/1948), p. 63.

“Cancers, tumors, and all inflammatory diseases are largely caused by meat-eating. . . . The mortality caused by meat-eating is not discerned; if it were, we would hear no more arguments and excuses in favor of the indulgence of the appetite for dead flesh” (White, 1896), p. 278.

“Grains, fruits, nuts, and vegetables constitute the diet chosen for us by our Creator. These foods, prepared in as simple and natural a manner as possible, are the most healthful and nourishing. They impart a strength, a power of endurance, and a vigor of intellect, that are not afforded by a more complex and stimulating diet” (White, 1905), p. 81.

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