Predictors of Healthy Aging in Men With High Life Expectancies

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ABSTRACT

Objective. The purpose of this study was to identify risk factors that consistently predict staying healthy in contrast to developing clinical illness and/or physical and mental impairments.

Methods. More than 8000 men of Japanese ancestry were followed for 28 years with repeat examinations and surveillance for deaths and incident clinical illness. Physical and cognitive functions were measured in 1993. Measures of healthy aging included surviving and remaining free of major chronic illnesses and physical and cognitive impairments.

Results. Of 6505 healthy men at baseline, 2524 (39%) died prior to the final exam. Of the 3263 available survivors, 41% remained free of major clinical illnesses, 40% remained free of both physical and cognitive impairment, and 19% remained free of both illness and impairment. The most consistent predictors of healthy aging were low blood pressure, low serum glucose, not smoking cigarettes, and not being obese.

Conclusions. Beyond the biological effects of aging, much of the illness and disability in the elderly is related to risk factors present at midlife. (*Am J Public Health.* 1998;88:1463–1468)

Healthy aging has become an issue of critical importance in our aging world. The well-recognized increase in the size of the population 65 years of age and older and age-associated increases in chronic disease and disability have led to an unprecedented financial burden in terms of medical care. Accumulating evidence from epidemiological studies, however, indicates that poor health in late life is not inevitable and that extrinsic, modifiable risk factors make a much greater contribution than is generally recognized.[1] Since prevention is one of the viable alternatives to the increasing cost of medical care, there is an important need to understand what modifiable risk factors consistently predict healthy aging and to use this information as the scientific basis for systematic interventions designed to enhance the health of the elderly.

Men of Japanese ancestry residing in Hawaii have one of the highest life expectancies in the world, at more than 79 years.[2] The purpose of the present study was to examine concepts of healthy aging in a large cohort of Japanese American men who were middle aged when first examined in the mid-1960s and who have been followed for 28 years with attention to a wide variety of health status measures. As they approached 85 years of age, the so-called average biological limit to life,[3] these men provided an unusual opportunity to learn what can be realistically expected in terms of healthy aging and what factors predict staying healthy into late life.

A major difficulty in studying healthy aging is the definition of health itself, which affects both the frequency and predictors of the outcome. Building on studies of death and survivorship,[4,5] Benfante and coworkers[6] used the logic that factors predicting staying alive and free of major clinical disease could provide a meaningful basis for prevention. Guralnik and Kaplan[7] proposed that a high level of physical function provides an overall measure of the impact of diseases and the accommodation to them. In their early work, Jette and Branch[8] used the concept of domains of disability and distinguished among 4 types: physical, mental, emotional, and social. Katz and coworkers[9] offered the concept of "active life expectancy," a term for the expected duration of functional well-being, and Rowe and Kahn[1] introduced the concept of "successful aging," defined as little or no loss in regard to a constellation of physiologic functions. There is major overlap among these many definitions but little agreement about a meaningful approach to the study of healthy aging.[10–14]

The main concept for the development of this study was the idea that when trying to develop guidelines for prevention policy in the elderly, it is important to consider factors associated with a broad range of clinical illnesses and disabilities rather than with a single illness or disability. For example, it can be more cost-effective to focus prevention efforts on risk factors (such as cigarette smoking) that can cause a variety of illnesses, and it can be helpful to have a broad perspective on risk factors (such as alcohol use) that can be protective for one disease while causally related to others. We have also adopted some of the concepts presented

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by Terris[15] in a thoughtful article on the epidemiology of health. In defining health, he included the following assumptions. First, since health and pathologic disease (which may be subclinical) may coexist, one cannot construct a continuum to show their relationship. However, health and clinical illness are mutually exclusive and can be described as lying at opposite extremes of a continuum. Second, within this health–illness continuum there are 2 major aspects of health, the subjective aspect of feeling well or ill and the objective aspect of ability to function. Both of these aspects can affect an individual's quality of life, but severity of illness is more often related to degree of interference with function.

Accordingly, we have defined healthy aging as surviving to late life free of major life-threatening illnesses and maintaining the ability to function physically and mentally. This approach differs conceptually from those of most of the recent prospective studies of healthy aging in 2 important ways. First, many of these studies focused on physical function as the outcome measure of health and used illness as a predictor variable rather than part of the constellation of health.[6,16,17] Second, there has been a tendency to include individuals with prevalent illness at baseline and to use their status as a predictor variable. Since illness existing at baseline can alter baseline risk factors and the risk of other diseases (e.g., coronary disease can depress blood pressure, change behavior, and increase the risk of stroke), we followed the usual design of incidence studies and included only individuals who were free of known clinical illness at baseline. The emphasis of the present study was on the search for common denominators among the different aspects of healthy aging; the study was not intended to be a study of specific illnesses or impairments.

Methods

Study Population

The cohort under study originated with the Honolulu Heart Program, a prospective investigation of cardiovascular disease among 8006 men of Japanese ancestry who were born during the years 1900 to 1919 and were living on the island of Oahu, Hawaii, in 1965. The men ranged in age from 45 to 68 years when they participated in baseline examinations conducted from 1965 to 1968. Surviving men participated in 3 follow-up examinations. The latest of these, exam 4, was conducted between 1991 and 1993 and, as part of the Honolulu-Asia Aging Study, included measures of physical, mental, and sensory function. In addition to these examinations, all study participants were subject to routine ongoing surveillance of hospital discharge records on the island of Oahu and to monitoring of death records from the beginning of the study to date. Details of the examinations, follow-up methods, and diagnostic standards have been reported elsewhere.[18–20]

Risk Factor Measures

All of the putative risk factors for sustained healthy aging were obtained from the baseline examinations (1965–1968). Information concerning demographic characteristics, lifestyle habits, and medical history was obtained by interview. Blood pressure was measured 3 times with a standard mercury sphygmomanometer, and the mean value was used. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. BMI at 25 years of age was calculated according to reported weight at age 25. Grip strength in the dominant hand was measured with a Stoelting dynamometer. Spirometry was performed at baseline, but most measures of forced vital capacity were rejected because they did not meet the criterion of a 6-second duration.[21] Initial-second forced expiratory volume (in liters) was therefore used here rather than the usual percentage of total forced vital capacity. Serum cholesterol, triglyceride, uric acid, and glucose were measured via Autoanalyzer methods on serum collected 1 hour after a 50-g glucose load.[18]

A Japanese diet score, based on a questionnaire concerning the usual intake of 10 common Japanese foods and 10 Western foods, was computed. This score was the ratio of intake of Japanese foods to total intake. Alcohol intake was calculated from reported usual monthly intake of beer, wine, and liquor and converted to milliliters of ethanol per day. For both current and former smokers, cigarette pack-years were calculated from reported usual number of cigarettes smoked per day multiplied by number of years smoked. A physical activity index was based on one used in the Framingham study,[22] in which approximate oxygen consumptions of different levels of an activity were multiplied by reported usual numbers of hours per day engaged in that activity.

Education was recorded in terms of school level completed. Current occupation was recorded by skill level (unskilled to professional). Years in Japan during early life (birth to 18 years of age) was based on age of migration for men born in Japan or on years of schooling in Japan for those who were sent to Japan for education.

Outcome Measures

Diagnosis of incident illnesses was based on information and laboratory test results from the 3 follow-up examinations and from mortality and hospital discharge records. Nonfatal coronary heart disease included myocardial infarction documented by electrocardiogram or enzyme evidence and surgical treatment for coronary disease. All stroke diagnoses were made by a neurologist according to criteria described earlier.[23] Cancer incidence was diagnosed from hospital surveillance and linkage to the Hawaii Tumor Registry.[24] Diabetes incidence was based on medical records of treatment for diabetes and exam 4 laboratory results; criteria of the World Health Organization (fasting blood sugar level of 140 mg/dL or greater or a 2-hour postload glucose level of 200 mg/dL or greater) were used. Chronic obstructive lung disease was based on exam 4 information indicating a history of chronic cough and phlegm for 3 or more months a year for 2 or more years and/or a physician-confirmed diagnosis of emphysema. Information concerning Parkinson disease was obtained from hospital records and review of medical records of 8 of 10 island neurologists.[25] Information concerning the other illnesses was obtained from specific questions concerning medically treated conditions in the follow-up examinations and from hospital discharge records.

Judgments of physical and cognitive function were based mainly on observed results of performance tests given at exam 4. Physical function was initially divided into upper and lower extremity function and later combined into a single measure. Tests for lower extremity function included the ability to walk 10 ft (3 m) in 4 seconds or less and the ability to stand up 5 times from a chair without use of arms in 15 seconds or less. These cutpoints were based on examination of the frequency distributions of the measures and represent the best estimate of the men who could and could not perform the test. Tests for upper extremity function included the ability to reach above the head, lift 10 lb (4.5 kg), grasp small objects, fully rotate the right shoulder, and exhibit a dominant hand grip strength of 26 kg or more. Normal function was defined as the ability to complete all of the tests.

Cognitive function was based on 3 measures: observed normal orientation during exam 4, absence of a medical history of memory problems, and a score of 74 or higher on the Cognitive Abilities Survey Instrument. This test has a score range of 0

to 100 and provides quantitative assessments of attention, concentration, orientation, short-term memory, long-term memory, language ability, visual construction, list-generating fluency, abstract thought, and judgment.[20,26] The cutpoint of 74 or lower was chosen for the exam 4 participants to include the lowest 15% of scores. Estimated sensitivity was 83%, and specificity was 96% for dementia of any type.

Statistical Analysis

The associations of risk factors with the different outcomes of healthy aging were first examined by calculating age-adjusted rates of events by quartiles of continuous measures or categories of the other measures. Variables that had associations ($P \leq .1$) in logistic regression with age were then included together in multivariate models to examine their independent associations with the different outcomes. Quadratic and log transformations of the predictor variables were explored when nonlinear associations so indicated. As a means of facilitating comparisons with other populations, rates were age-adjusted to 1993 Bureau of the Census estimates.

Cox proportional hazard models[27] were used to assess associations between the exam 1 risk factors and survival to the 1993 closing date of exam 4. Survival (odds) ratios and 95% confidence intervals were calculated for "interquartile differences" (differences between the median values for men in the highest vs lowest quartile of the risk factor). Categorical variables were generally dichotomized to facilitate comparisons.

The SAS CATMOD procedure, modified for logistic regression,[28] was used to assess associations of the exam 1 risk factors with the different, mutually exclusive categories of health among the men who participated in exam 4. This procedure had the advantage of allowing, in 1 model, separate analyses of associations between baseline risk factors and polychotomous outcomes (e.g., healthy men vs those with incident illness and healthy men vs those with functional impairment).

Results

Of the 8006 men who participated in exam 1, 1501 were excluded because they died within 1 year of completing the exam or had prevalent medically diagnosed clinical illnesses, including coronary heart disease, stroke, cancer, diabetes, gastrectomy, and chronic lung, kidney, or liver disease. Review of all hospital discharge records for dementia revealed no cases prevalent at the time of that exam. The remaining 6505 men were defined as the healthy baseline population. Of these individuals, 2524 (39%) died prior to completion of exam 4 in December 1993. Of the 3981 survivors, 3263 (82%) completed exam 4 and were included in analyses of the development of clinical illness and functional impairment. The 718 men who were alive but did not participate in exam 4 were similar to the examined men in terms of incident clinical illness diagnosed in earlier examinations and surveillance of hospital discharge records. In terms of the risk factors that predicted healthy aging, the nonrespondents had higher blood pressure and serum glucose levels and smoked more cigarettes.

TABLE 1—Significant Risk Factors Predicting Survivorship Among Healthy Exam 1 (1965–1968) Men: Honolulu Heart Program, Oahu, Hawaii

	Interquartile Range	Survival Ratio	95% Confidence Interval
Biologic measures			
Age, y	10	0.48	0.43, 0.53
Systolic blood pressure, mm Hg	46	0.67	0.61, 0.75
Serum glucose, mg/dL	109	0.78	0.71, 0.85
Serum uric acid, mg/dL	3.3	0.88	0.79, 0.99
BMI at age 25, kg/m^2	4.8	0.87	0.78, 0.96
Forced expiratory volume, L	1.1	1.47	1.30, 1.65
Health habits			
Cigarette pack-years	65	0.72	0.65, 0.79
Alcohol intake, mL/d	40	0.89	0.82, 0.96
Sociodemographic characteristics			
Not married		0.80	0.68, 0.95

Note. Values were derived from a Cox proportional hazard model including all variables. All listed survival ratios are significant at a P value of .05 or less. BMI = body mass index.

Survival

The first step in the analyses was to compare the 3981 survivors with the 2524 men who died prior to exam 4. Table 1 shows the survival ratios and 95% confidence intervals from multivariate Cox models involving the baseline exam risk factors that were significantly associated with survival at a P value of .05 or less. Interquartile range values indicate the differences between the median point of the highest and lowest quartiles of the continuous variables, except for age, which was set at 10 years. A ratio of less than 1 indicates an inverse or negative association with survival.

Survival was predicted by low values in terms of age, systolic blood pressure, serum glucose, serum uric acid, BMI at age 25, cigarette use, and alcohol intake, as well as by high forced expiratory volume and being married. Separate analyses showed no significant associations for log and quadratic values of serum cholesterol and BMI, quadratic levels of alcohol intake, measures of physical activity, Japanese diet score, occupation level, education, or hematocrit. High grip strength was associated with survival at a borderline level of significance.

Clinical Illness and Impairment

Table 2 shows the percentages of the 3263 men completing exam 4 who remained free of known clinical illness and of physical and cognitive impairment. One hundred nine men with missing data on physical or cognitive function were removed from analyses including those outcomes. A total of 1347 men (41%) were free of clinical illness. The 1916 men who had developed 1 or more clinical illnesses included 25% with coronary heart disease, 6% with stroke, 21% with cancer, 46% with diabetes, 23% with arthritis, 6% with chronic lung disease, 3% with Parkinson disease, and 15% with gastrointestinal, liver, or kidney disease. Between 62% and 75% of the men remained free of physical or cognitive impairment. For each type of impairment, there was a clear decrease in the percentage of unimpaired men with increasing age.

The group of 610 men who met the definition of healthy aging by being free of clinical illness as well as physical and cognitive impairment represented 19% of those participating in exam 4 who could be classified. By age group, the percentages of healthy men ranged from 6% of those who were 85 years of age or older to 26% of those who were 70 to 74 years of age.

Three groups were defined for contrast with the 610 healthy men (in the CATMOD logistic regression models) to allow examination of the variables that might predict healthy aging. Group 1 included 1279 men with both clinical illness and physical and/or cognitive

TABLE 2—Percentages of Exam 4 (1991–1993) Men Free of Known Clinical Illness and of Physical and Cognitive Impairment, by Age: Honolulu Heart Program, Oahu, Hawaii

Age, y	No.	No Clinical Illness, %	No Physical Impairment of Extremities, %		No Cognitive Impairment, %	No Illness or Impairment, %
			Upper	Lower		
70–74	948	43	73	82	83	26
75–79	1338	40	63	70	77	21
80–84	606	41	51	51	70	13
85+	371	42	26	28	42	6
Total[a]	3263	41	67	62	75	19

[a]Age adjusted to 1993 Bureau of the Census estimates; 109 men had missing information on physical or cognitive function and were not included in calculations concerning impairments.

TABLE 3—Significant Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Variables Contrasting Healthy Men and Groups With Illness and Impairment: Honolulu Heart Program, Oahu, Hawaii

	Interquartile Range	Group 1: Healthy vs Illness With Impairment	Group 2: Healthy vs Illness Without Impairment	Group 3: Healthy vs Impairment Without Illness
		OR (95% CI)	OR (95% CI)	OR (95% CI)
Biologic measures				
Age, y	10	0.38 (0.28, 0.51)	. . .	0.33 (0.24, 0.46)
Systolic blood pressure, mm Hg	46	0.57 (0.42, 0.78)	0.60 (0.42, 0.85)	0.71 (0.50, 0.99)
Serum glucose, mg/dL	109	0.37 (0.28, 0.50)	0.33 (0.24, 0.45)	. . .
Serum triglyceride, mg/dL	282	. . .	. . .	1.41 (1.09, 1.63)
Hematocrit, %	7	. . .	0.69 (0.50, 0.96)	. . .
BMI[2], kg/m^2	327	0.44 (0.32, 0.59)	0.71 (0.51, 0.99)	. . .
Grip strength, kg	15	2.80 (2.06, 3.78)	. . .	3.27 (2.33, 4.58)
Height, in	5	. . .	. . .	1.46 (1.06, 2.00)
Health habits				
Cigarette pack years	65	0.52 (0.39, 0.70)	0.46 (0.33, 0.64)	. . .
Sociodemographic characteristics				
Occupation (high/low)	. . .			1.45 (1.04, 2.04)
Years in Japan	13	0.64 (0.44, 0.92)	. . .	0.65 (0.44, 0.97)
Japanese diet score, %	38	0.76 (0.59, 0.97)	. . .	. . .
Not married	. . .	. . .	2.06 (1.10, 3.87)	. . .

Note. Values were derived from CATMOD logistic regression models for polychotomous outcomes. All odds ratios are significant at a *P* value of .05 or less. BMI = body mass index.

impairment. That is, among those men with 1 or more illnesses, 419 also had both physical and cognitive impairment, 686 had physical impairment, and 174 had cognitive impairment. Group 2 included 589 men with clinical illness but without physical or cognitive impairment. Group 3 included 676 men with physical and/or cognitive impairment but without clinical illness. Of these individuals, 171 had both physical and cognitive impairment, 445 had only physical impairment, and 60 had only cognitive impairment.

Table 3 shows the odds ratios of the baseline risk factors that significantly predicted staying healthy in contrast to these 3 separate groups. In group 1, low values for age, blood pressure, serum glucose, BMI^2, cigarette pack-years, childhood years in Japan, and Japanese diet score, along with high grip strength, predicted staying healthy. The results were similar for group 2, except that age, grip strength, years in Japan, and Japanese diet score were not significant, while low hematocrit and being unmarried were. In group 3, low values for age, blood pressure, and childhood years in Japan, along with high values for serum triglyceride, grip strength, height, and occupation, predicted staying healthy. When the healthy men were compared with all 3 groups of ill or impaired men combined as a single outcome, the significant risk factors were identical to those described for group 1.

In separate analyses, there were no significant associations for serum cholesterol, quadratic and log transformations of cholesterol, serum uric acid, BMI at age 25, forced expiratory volume, alcohol intake, physical activity, education, or type of diet preference.

Discussion

The wealth of information from this large cohort, which has been followed for 28 years, provides a perspective of what can be expected in terms of healthy aging in a group of men with a very long life expectancy. Of the 3263 men who were 71 to 95 years of age when seen at exam 4, 41% were free of major clinical illness, 40% were free of physical and cognitive impairment, and 19% were free of both clinical illness and impairment. It is important to note that these rates are dependent upon the definitions of health and function used in this study. If the definitions had included suspected cases of illness and hearing and vision impairments, estimates would have been lower; if the measures of physical function had been more liberal, estimates would have been higher.

Adjusted for age, the common denominators for predicting survival and sustained freedom from clinical illness and from physical and cognitive impairment were low blood pressure and serum glucose, not smoking cigarettes, and not being obese. High forced expiratory volume and low alcohol intake were strong predictors of survival but were not

TABLE 4—Comparison of Predictors of Healthy Aging From Prospective Studies

	Present Study		Alameda County Study[7]		Manitoba Study[29] (Both Survival and Function)	MacArthur Study[17] (Function)
	Survival	Function	Survival	Function		
Biologic measures						
High blood pressure	↓	↓	↓	↓	...	↓
Serum glucose/diabetes	↓	↓	0	0	↓	↓
Serum uric acid	↓	...	...	...	...	...
Obesity	↓	↓	↓	↓	...	↓
Grip strength	0	↑	...	...	...	...
Lung function	↑	0	...	...	...	↑
Health habits						
Cigarette use	↓	↓	↓	↓	...	0
Physical activity	0	0	...	...	...	↑
Alcohol use	↓	0	↑	↑	...	0
Baseline conditions						
Poor health/disease	...	...	↓	↓	↓	↓
Poor function	...	...	↓	↓	↓	0
Poor cognition	...	...	...	...	↓	↓
Sociodemographic characteristics						
Social support	...	...	...	...	0	↑
Life satisfaction	...	...	...	...	↑	0
High education	0	0	...	...	0	↓
High income	...	...	↑	↑	0	↑

Note. See text for study details. ↑ = statistically significant direct association; ↓ = indirect association; 0 = no significant association.

independently related to the other outcomes. High grip strength had a borderline association with survival and predicted remaining free of clinical disease and impairment. This variable may be a surrogate indicator of physical fitness. The physical activity measure, however, was not associated with any of the outcomes. This result was unexpected but consistent with earlier findings concerning chronic diseases in this cohort.[6,19,23] One possible explanation relates to the removal of men from the study who had illnesses, which could have confounded the association between physical activity and health. For example, men with chronic lung disease or congestive heart disease have a high risk of physical impairment and death and may be less physically active. With such men included in a study, it would be difficult to determine whether disease causes low activity or whether low activity causes disease.

There were few consistent associations among the measures of social and demographic characteristics. Men who remained free from clinical illness and impairment had higher occupational skill levels and had spent fewer childhood years in Japan. Unmarried men had lower survival rates but less impairment. Education was not associated with any of the outcomes in the multivariate models, although it was directly associated when examined with only age.

Because some of these findings may be related to certain cultural or environmental aspects of this cohort, it is important to make comparisons with findings from other prospective studies of healthy aging (see Table 4). The Alameda County Study[7] was quite similar to the present study in terms of age of cohort and time period of study. The 841 individuals born between 1895 and 1919 were followed from 1965 to death or a follow-up interview in 1984. The 2 aspects of healthy aging outcomes were survival and being in the highest quintile of physical function. The investigators did not exclude individuals with clinical illness or disability at baseline but used indicator variables of these conditions in statistical models. By 1984, 41% of the cohort had died, 46% had physical function problems, and 13% were healthy. After adjustment for age and functional status at baseline, the variables that predicted healthy outcomes included absence of hypertension, arthritis, and back pain; not smoking; normal weight; moderate intake of alcohol; high income; and White ethnicity. Since physical activity was part of the outcome, it could not be evaluated. No laboratory measures were available.

Strawbridge and coworkers[16] extended the Alameda County Study by following 356 of the individuals who were 65 to 95 years of age in 1984 and still alive in 1990. Their definition of successful aging was "minimal interruption of usual function, although minimal signs and symptoms of chronic disease may be present." They judged 35% of the cohort to be aging successfully in 1990, down from 60% in 1984. Baseline predictor variables included not having diabetes, chronic obstructive lung disease, arthritis, or hearing problems. Among behavioral factors, having close personal contacts, walking for exercise, and not reporting depression were significant, while alcohol use and cigarette use were not. High income and education were of borderline significance.

Most of the other studies involved cohorts of individuals who were more than 65 years old at baseline. Roos and Havens[29] followed a group of 2943 individuals who were 65 to 84 years of age in 1971 for 12 years. Their definition of "successful aging" included surviving, functioning well at home, and remaining mentally alert. At the end of the follow-up, 57% had died, 23% were impaired, and 20% were healthy. Of more than 100 baseline measures, only high self-rated health, high mental status, good life satisfaction, and not having cancer or diabetes, and not having to retire because of poor health predicted healthy aging. None of the baseline measures of socioeconomic status were significant predictors. No biological laboratory tests or information on health habits such as smoking, alcohol intake, and physical activity were available.

The investigators working on the MacArthur studies of successful aging used a different approach.[17,30] They began with an elderly cohort (70–79 years of age) of 1192 "relatively high-functioning" individuals and followed them for 3 years to determine changes in physical performance. High function was defined as being in the top one third of an age group in terms of physical and cognitive function. Decline in physical function was predicted by high levels of education, rel-

ative weight, and blood pressure; low levels of income, physical activity, and peak expiratory flow; poor cognitive function; lack of emotional support; and prevalent diabetes and incident chronic diseases. Cigarette smoking and alcohol intake were not significant.

In an earlier report,[6] we emphasized the need for a series of imaginative studies of healthy aging done in diverse ways among different populations so that the most robust predictors would emerge. The series to date is modest, and there are many differences in methods and definitions; there are, however consistent findings. Low levels of the known risk factors for major chronic diseases (blood pressure, serum glucose, smoking, and obesity) and an absence of chronic diseases themselves are consistent predictors of healthy aging. Education and income were implicated in several of the studies, but not all, and the findings on alcohol intake and physical activity have been inconsistent.

In addition to these studies, there is now overwhelming evidence that, beyond biological aging, most of the physical disability and need for long-term medical care in the elderly are caused by clinical illness, including heart disease, stroke, diabetes, arthritis, vision loss, and hip fracture.[10–12,31–34] As noted by Guralnik,[35] there is a need for greater understanding of the many factors that influence the pathways from disease to disability, but our current knowledge indicates that preventing the diseases themselves is a critical priority.

In spite of the growing recognition of the importance of disease prevention in the elderly, there is little in the way of a unified, systematic policy for individual, community, and national interventions.[36,37] The accumulated results of studies on healthy aging have shown that it is possible to identify important modifiable risk factors that cause a great amount of illness and disability. Much of the underlying disease pathology begins in childhood and young adult life, but we are learning that it is never too late to benefit from intervention in late life, as evidenced by trials of blood pressure reduction and smoking cessation in the elderly.[38,39] It therefore seems quite plausible to make intervention involving these known risk factors the first step of a systematic policy for promotion of healthy aging. □

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