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A number of personal health practices show a striking inverse relationship with mortality rates, especially for men.

Relationship of Health Practices and Mortality[1]

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This paper explores the relationship of a number of personal health practices and mortality in the 5½ years after a survey made in Alameda County, California in 1965. Age-adjusted mortality rates were higher for men, for persons reporting disability, and for those with inadequate incomes.

The individual health practices, smoking, weight in relation to desirable standards for height, drinking, hours of sleep, regularity of meals, and physical activity, were related to mortality in the expected direction. When accumulated to form a health practice score from 0 to 7, the number of health practices showed a striking inverse relationship with mortality rates, especially for men. This relationship was independent of income level and physical health status.

The age-specific death rates by number of health practices were used to develop a life table. The average life expectancy of men aged 45 who reported six or seven "good" practices was more than 11 years more than that of men reporting fewer than four. For women the relationship between health practices and mortality was less strong, and the difference between the life expectancy at age 45 for those who reported six or seven, and those who reported fewer than four, was 7 years.

The length of man's life is undoubtedly influenced by countless factors, only some of which are under his control. These factors range from cataclysms of nature through accidents, epidemic diseases, and hereditary endowments, to a host of less obvious and more subtle influences such as environmental pollution, stress, and life style, including common personal health practices. The studies of the Human Population Laboratory of the California State Department of Public Health were developed to explore the relationship between health, as broadly defined, and ways of living.

Much of the research which has been done in this field has dealt with selected populations, and often with relatively small numbers. The Human Population Laboratory, in contrast, has surveyed a probability sample of almost 7000 persons, which is representative of the general adult population of a typical California urban community.

Previous reports have dealt with measures of physical health status (2), and mental health status (5). Forthcoming is a measure of social health developed from the component variables of employability, marital satisfaction, community involvement, and sociability (26). Central to the concept of health is the idea that a healthy individual is one who is able to function in his role in society.

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The most recent paper in this series (4) has shown that certain personal health practices, namely, hours of sleep, regularity of meals, weight in relation to desirable standards for height, smoking, drinking, and physical activity, were related to physical health status. Those who followed all of the "good" practices were in better health at every age than those who followed none or few.

This paper continues to probe the relationship between physical health status, health practices, and other variables by examining the mortality experience of the population in the $5\frac{1}{2}$ years after the survey.

METHODS

During the spring and summer of 1965, an area probability sample of noninstitutional adult residents of Alameda County, California was surveyed. Enumerators visited the households in the sample, recorded the basic demographic information, explained the purpose of the study, and left copies of a 23-page questionnaire with instructions and a return envelope. After certain follow-up procedures were carried out, usable questionnaires were received from 86% of the enumerated population (13).

The questionnaire covered medical conditions, symptoms, impairments and disabilities, personal health practices, family life, social and recreational activities, employment, family history, education, and income, as well as a number of feelings, attitudes, and expectations.

Decedents were located by a computer matching operation which is reported elsewhere (3). The procedure used the death records registered in California, and missed any individuals who moved from the State. Among the 6928 persons included in the survey, matching death certificates for 371 were located. For the calculation of rates, all persons for whom death certificates were not located were considered to be still living at the end of 1970. The mortality rates are thus somewhat understated. Any bias which is introduced into the comparison between rates in relation to other variables, depends, of course, upon whether those with a particular characteristic were more or less likely to have moved.

Since age is the most important single variable in determining risk of death, the mortality rates used are age specific or adjusted for age.

FINDINGS

Physical health status was measured along a spectrum ranging from severely disabled (reported having trouble with feeding, dressing, climbing stairs, getting outdoors, or inability to work, for 6 months or longer) through lesser disability (reported changing hours or type of work or cutting down on other activities for 6 months or longer), and chronic conditions or symptoms to no complaints with varying degrees of energy level. Only the severely disabled category was predictive of increased risk of death for both men and women. The mortality rate for men with severe disability was 0.143; for women, 0.097. Men with lesser disability had a mortality rate of 0.097, substantially higher than in the remaining five health status categories, while women with lesser disability were comparable to those in the other five groups (0.042 compared with 0.030–0.043). The overall mortality rate of men

TABLE I
AGE-ADJUSTED MORTALITY RATES[a] BY PHYSICAL HEALTH STATUS

Physical health status	Number in survey	Mortality rates[a]		
		Both sexes	Men	Women
Total	6928	.055	.066	.044
Severely disabled	477	.120	.143	.097
Lesser disability	547	.070	.097	.042
Two or more chronic conditions	594	.051	.065	.038
One chronic condition	1345	.044	.058	.030
Symptomatic	1946	.040	.045	.036
Without complaints, medium or low energy	1584	.048	.063	.033
Without complaints, high energy	435	.036	.030	.043

[a] Proportion dying in 5½ years.

was nearly 50% higher than that of women. This differential was reversed only in the most favorable category—no complaint with high energy level.

Since persons with disability are less mobile than those without, the record linkage may have missed more decedents in the five categories at the upper end of the spectrum than in the disabled categories. For this reason the differentials shown in Table I may be overstated.

Mortality rates have long been known to be associated inversely with income level. In Table II, income categories are based on family income and number of persons in household. Inadequate income, for example, was defined as less than $3000 for one or two persons, less than $4000 for three or four persons, less than $5000 for five or six, and less than $6000 for seven or more. Mortality rates were higher for those with inadequate incomes, but above the poverty level there was little difference in mortality by income level.

Personal health practices, such as hours of sleep and regularity of meals were found to be slightly, but significantly, associated with physical health status (4). The degree to which these practices are associated with mortality is shown in detail, by age group and sex, by the rates in Table III.

TABLE II
AGE-ADJUSTED MORTALITY RATES[a] BY INCOME LEVEL BY SEX

Income level	Number in survey	Mortality rates		
		Both sexes	Men	Women
Inadequate	844	.069	.084	.054
Marginal	1017	.059	.068	.050
Adequate	3010	.056	.064	.049
Very adequate	1687	.050	.063	.037

[a] Proportion dying in 5½ years.

TABLE III

MORTALITY RATES (Proportion dying in 5½ years) BY HEALTH PRACTICES BY AGE AND SEX[a]

Health practice	Men						Women					
	Age-adjusted rate	Under 45	45–54	55–64	65–74	75+	Age-adjusted rate	Under 45	45–54	55–64	65–74	75+
Weight/height—Desirable mean												
10% or more below	.148	.008	.133	.467	.444	.526	.064	.009	.075	.064	.179	.485
5–9.99% below	>.081	−(159)	.053	.188	.250	.583	.035	.003	−(67)	.048	.176	.294
±4.99%	>.075	.008	.060	.132	.322	.351	.041	.007	.017	.048	.161	.325
5–9.99% above	.051	.016	.018	.092	.200	.231	>.034	.012	.026	.038	.053	.296
10–19.99% above	>.047	.010	.036	.065	.149	.316	>.036	−(216)	.026	.059	.150	.244
20–29.99% above	>.056	.006	.060	.066	.212	.333	.054	.010	.044	.088	.095	.454
30% or more above	.084	.029	.019	.074	.333	.600	.047	.020	.020	.055	.167	.250
Smoking history												
Never	>.042	.004	.020	.045	.134	.417	>.036	.005	.024	.040	.102	.324
Formerly	>.060	.007	.021	.098	.278	.368	>.066	.004	.028	.111	.258	.500
Now	.084	.015	.068	.156	.337	.333	.065	.010	.030	.053	.258	.571
Amount now smoke												
<1 pack/day	.084	.009	.048	.068	.293	.800	.060	.013	.019	.057	.188	.571
1–1½ pack/day	.079	.015	.076	.180	.341	.125	.063	.009	.035	.045	.333	.400
2+ pack/day	.109	.028	.071	.200	.500	−(1)	*	−(68)	−(24)	.111	−(0)	1.0(2)
Amount drink												
None	.064	.005	.058	.080	.273	.386	.048	.009	.026	.080	.165	.319
1–2 at one time	.061	.006	.030	.121	.217	.422	.041	.004	.029	.041	.136	.361
3–4 at one time	>.069	.011	.070	.086	.357	.200(5)	*	.014	.024	.044	−(9)	.500(2)
5 or more at one time	>.065	.026	.052	.118	.222	−(1)	> *	.012	−(19)	.125	−(1)	−(0)

TABLE III (cont.)

Health practice	Men						Women					
	Age-adjusted rate	Under 45	45–54	55–64	65–74	75+	Age-adjusted rate	Under 45	45–54	55–64	65–74	75+
Physical activity												
Often active sports	.038	.009	.026	.059	.143	.200	*	.010	.016	.048	−(5)	−(0)
Often swim, garden, exercise	.063	.014	.051	.105	.221	.317	.033	.004	.019	.051	.110	.250
Sometimes sports or swim	>.060	.005	.066	.061	.154	.533	>.042	.011	.031	.059	.150	.231
Sometimes garden or exercise	.080	.014	.019	.152	.303	.539	.043	.006	.011	.044	.184	.366
Never any of above	.114	.031	−(33)	.300	.483	.476	.067	−(106)	.085	.088	.224	.476
Eat breakfast												
Almost every day	>.059	.009	.040	.100	.210	.371	>.042	.006	.031	.055	.130	.326
Rarely or sometimes	>.106	.012	.061	.147	.472	.667	>.061	.008	.017	.057	.256	.538
Eat between meals												
Rarely or occasionally	>.062	.009	.045	.092	.283	.375	>.042	.007	.026	.052	.144	.328
Almost every day	>.086	.012	.048	.183	.300	.500	>.049	.007	.027	.067	.151	.414
Hours of sleep												
6 or less	>.090	.033	.071	.145	.219	.476	>.040	.008	.019	.047	.188	.241
7	>.063	.004	.052	.121	.214	.389	>.036	.004	.016	.044	.126	.328
8	>.057	.010	.028	.079	.287	.278	>.046	.010	.029	.062	.121	.366
9 or more	>.066	−(100)	.038	.118	.241	.524	>.066	.005	.074	.079	.189	.522

[a] Note: Critical levels for Health Practice Score were determined by the relationship to physical health status, and are indicated by >; − = no deaths. Number in parentheses is the denominator; * Insufficient numbers in some age categories to calculate age-adjusted rate.

Weight

Several of the personal health practices which were covered in this survey have been investigated by others in relation to mortality. Life insurance studies have shown that overweight men have higher mortality than men of average or less than average weight, and that the greater the degree of overweight the larger the excess mortality (17). These studies have shown similar results for women but the degree of excess mortality among women is less than it is among men (18).

Our findings indicated the highest mortality for both sexes was in the group 10% or more under the desirable weight standard for height (19), suggesting the possible effect of debilitating disease. Persons known to have such conditions would, of course, not be included in life-insurance study populations.

The most favorable mortality experience for men was in the weight groups from 5–19% overweight; for women there was little difference in mortality in the weight groups between 5–9% underweight and 10–19% overweight. The National Health Examination Survey (22) showed average weights somewhat higher than the insured population upon which the desirable weights were based, suggesting that the standards used here may be low. Our findings showed increased mortality for those more than 20% overweight, and especially for men more than 30% overweight.

Smoking

Our findings on mortality in relation to smoking history are in accord with those of other investigators (1,10,12,15,31). Persons who had never smoked had the least risk of death, and the men who smoked two or more packs per day had the highest age-adjusted mortality rate. Few women reported smoking as many as two packs per day, but those who smoked at all experienced higher mortality than those who had never smoked.

Drinking

Schmidt and de Lint (27) have shown that the mortality of alcoholics followed for 2–14 years after treatment in a clinic was twice as high for men and three times as high for women as expected in the general population. The ratios of observed to expected deaths were markedly higher for men under the age of 50 and for women under the age of 45. The indication that alcoholics die at early ages would explain our finding so few heavy drinkers in the older age groups. Moderate drinkers (one to two at a time) had the most favorable mortality. Possibly the nondrinkers included some who were forced to stop drinking by ill health.

Physical Activity

A number of other studies have shown that physical activity is associated with longevity (9,14,16,23–25). In our study the men who reported that they often engaged in active sports had the lowest mortality, just half that experienced by men who reported that they only sometimes gardened or exercised. Few women reported participation in active sports; their lowest mortality was among those who reported swimming, gardening, and other exercise, and the

highest was among those who never engaged in recreational physical activity. It is not possible to infer causation in these relationships. Obviously, seriously ill or disabled persons will not be able to play tennis, swim, or otherwise take part in sports.

Other Health Practices

Some work has been done on the relationship between diet and mortality (28–30), but none has explored regularity of meals and hours of sleep. Eating breakfast and not eating between meals were associated with favorable mortality rates, especially for men. These practices were additive in their effect. Men who usually ate breakfast and only rarely or occasionally ate between meals had a mortality rate of 0.055, compared with 0.132 for those who did not eat breakfast and ate between meals almost every day. For women the cumulative effect was less dramatic.

Men who reported sleeping 8 hr had lower mortality rates than those who slept more or less. For women the optimum rate was for those who reported 7 hr of sleep, and those who slept 6 hr or less were not at a disadvantage with regard to mortality. Here again, the causal relationship is not clear. Illness may cause insomnia or a need for more sleep, rather than the reverse.

Health Practice Summary

The summary score for health practices which was used in the previous paper (4) was based upon dichotomies determined by the relationship with physical health status. For hours of sleep and weight of men, the extremes were combined to form the dichotomy, with the central values being favorable. The critical levels are indicated in Table III by the symbol >. The relationship with mortality is not always the same as with physical health status, but the differences are minor.

When the mortality rates were calculated for the dichotomies for the seven health practices and 10 age–sex categories, the differences in rates were in the expected direction in 56 of the 68 cells (omitting one tied value and one in which there were no frequencies). For example, the mortality rates for those who reported that they usually ate breakfast were lower in each age–sex category except women aged 45–54, where the reverse was true. Using the sign test at the 0.01 level, one might expect not more than 46 of the differences to be in the same direction by chance alone. The mortality differentials shown in Table III, even though small in many cases, are statistically significant, as a whole.

As shown in the previous paper, the health practices were not highly intercorrelated, and when they were accumulated to form a score ranging from 0–7, there was a direct association with physical health status. In Table IV, the mortality rates, adjusted for age, are shown by number of health practices. There is a pronounced gradient ranging from 0.018 for those who followed all seven practices to 0.105 for those who followed three or less. This gradient is stronger for men than for women, but even among the latter the difference between those following fewer than four practices and those following seven is almost 4-fold.

TABLE IV
AGE-ADJUSTED MORTALITY RATES BY HEALTH PRACTICE SCORE BY SEX

Health practice score[a]	Both sexes	Males	Females
Less than four	.105	.132	.078
Four	.068	.079	.057
Five	.052	.068	.036
Six	.050	.056	.045
Seven	.018	.015	.022

[a] Number of positive responses to the following items: usually sleep 7 or 8 hr; eat breakfast almost every day; eat between meals once in a while, rarely, or never; weight for men between 5% under and 19.99% over desirable weight for height; weight for women, not more than 9.99% over desirable weight for height; often or sometimes engage in active sports, swim or take long walks, or often garden or do physical exercises; drink not more than four drinks at a time; never smoked cigarettes.

The possible bias introduced by failure to find all of the decedents is probably in the direction of minimizing the differences in Table IV. Persons who reported following all seven "good" health practices were older than those who reported three or fewer (average ages 45.9 vs 40.8 years). Since younger people are more mobile than older ones (6), there is a greater likelihood that those following fewer good health practices were missed in the death clearance than those following all seven.

In Table V, age- and sex-specific mortality rates are shown by number of health practices. These rates are shown also in Fig. 1, except that four and five

TABLE V
MORTALITY RATES BY SEX AND AGE GROUP BY NUMBER OF HEALTH PRACTICES

Health practice score	5½-Year mortality rates[a]									
	Men					Women				
	Under 45	45–54	55–64	65–74	75+	Under 45	45–54	55–64	65–74	75+
Three or less	.02	.07	.31	.42	.75	.01	.03	.08	.33	.62
Four	.01	.05	.12	.30	.48	.01	.03	.11	.17	.44
Five	.01	.04	.11	.30	.36	.01	.01	.02	.17	.30
Six	.00	.04	.09	.18	.41	.01	.04	.05	.13	.31
Seven	–	.02	–	.06	.13	–	.02	.04	–	.29
	Number of persons in survey									
Three or less	283	74	29	24	8	274	91	50	21	8
Four	419	156	84	43	21	468	142	103	46	36
Five	526	181	117	77	36	648	219	124	114	63
Six	413	169	111	71	34	503	168	138	97	71
Seven	135	56	45	31	15	199	61	52	46	28

[a] – = no deaths.

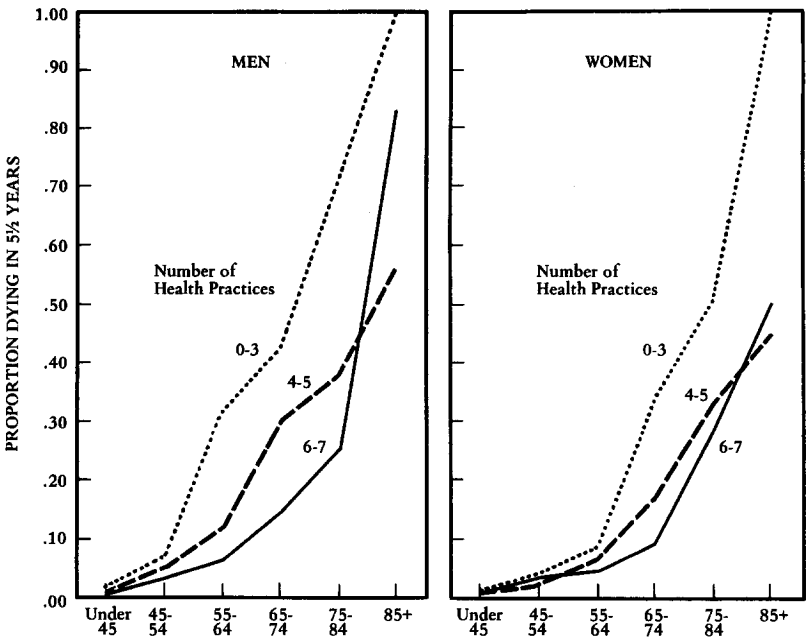

FIG. 1. Age-specific mortality rates by number of health practices, by sex.

health practices were grouped, as were six and seven, and the rates were carried to the age group 85 and over. Especially among the men, there was a marked and consistent relationship between mortality and number of health practices. Under 45 years of age, the overall mortality was low and differences probably insignificant, but after the age of 45 the differential widened with advancing age to the age group 75–84. There were only 14 men and 30 women over the age of 85 in the survey, so the rates for that age group were subject to very large sampling error. For women, the rates were slightly lower, and the differential between the group following zero to three practices and that following six to seven was about the same in the age group 55–64 as it was for men 10 years younger. Thereafter it widened in a pattern similar to that of the men.

Income and Health Status

Since mortality was related in some degree to both income and health status, the relationship between health practices and these variables must be considered. If the latter relationships were strong, health practices might indeed be an intervening variable, and the association shown in Table V and Fig. 1 might be merely the reflection of the underlying relationship between income and health status on one hand, and mortality on the other.

Table VI shows the differences in mortality rates for men and women by six health status categories for "good" and "poor" health practices. Dichotomization of health practices was necessary to obtain frequencies on which age-adjusted rates could be calculated. Obviously the dichotomy minimizes the

TABLE VI
AGE-ADJUSTED MORTALITY RATES (5½ year) BY PHYSICAL HEALTH STATUS AND HEALTH PRACTICES, BY SEX

Physical health status	Men		Women	
	Health practices		Health practices	
	Poor[a]	Good[b]	Poor[a]	Good[b]
Severely disabled	.159	.114	.100	.116
	(91)	(76)	(150)	(160)
Lesser disability	.124	.080	.065	.032
	(96)	(146)	(104)	(201)
Two or more chronic conditions	.095	.048	.059	.026
	(100)	(167)	(110)	(217)
One chronic condition	.062	.054	.043	.031
	(217)	(405)	(249)	(474)
Symptoms only	.038	.033	[c]	.047
	(325)	(450)	(386)	(785)
Without complaints	.073	.036	.071	.030
	(312)	(773)	(240)	(694)

[a] Four or less good health practices.
[b] Five to seven good health practices.
[c] Too few deaths to calculate age-adjusted rate.

differences in rates. None of the differences shown in Table VI is statistically significant (8), but in 10 of the 12 categories, those with poor health practices had higher mortality rates than those with good health practices, a finding which is significant ($P < 0.05$ by the sign test).

TABLE VII
AGE-ADJUSTED MORTALITY RATES (5½ year) BY INCOME LEVEL AND NUMBER OF HEALTH PRACTICES, BY SEX

Income level	Men			Women		
	Number of good practices			Number of good practices		
	0–3	4–5	6–7	0–3	4–5	6–7
Inadequate	.139	.107	[a]	.092	.044	.059
	(55)	(160)	(96)	(92)	(253)	(188)
Marginal	.177	.065	.052	.160	.053	.040
	(81)	(247)	(122)	(70)	(300)	(197)
Adequate	.098	.062	.048	.066	.053	.036
	(190)	(760)	(497)	(172)	(843)	(548)
Very adequate	.078	.086	.016	[a]	.032	.037
	(70)	(419)	(330)	(77)	(439)	(352)

[a] Too few deaths for calculation of age-adjusted rates. Numbers in parentheses are denominators.

TABLE VIII
AGE-ADJUSTED MORTALITY RATES BY PHYSICAL HEALTH STATUS, INCOME LEVEL, SEX, AND HEALTH PRACTICES

Physical health status and income level	Men		Women	
	Health practices		Health practices	
	Poor[a]	Good[b]	Poor[a]	Good[b]
With disability or chronic conditions[c]	.106	.068	.071	.043
Inadequate or marginal income	.117	.072	.080	.045
	(174)	(206)	(208)	(347)
Adequate or better income	.101	.066	.068	.043
	(303)	(556)	(367)	(625)
With symptoms or no complaints[c]	.047	.036	[d]	.042
Inadequate or marginal income	.063	.046	[d]	.050
	(147)	(234)	(193)	(352)
Adequate or better income	.041	.032	.040	.039
	(458)	(949)	(388)	(1051)

[a] Four or fewer good health practices.
[b] Five to seven good health practices.
[c] Adjusted for both age and income level.
[d] Too few deaths to calculate age-adjusted rate.

In Table VII, with income level in four categories, it was possible to divide health practices into three groups. In each income level except Very Adequate, the highest mortality rates were found among those who reported following three or fewer good health practices. In five of the seven categories for which comparison could be made the lowest mortality rates were found among those who followed six or seven good practices, and while this result does not meet the strict standard of statistical significance, the pattern of rates in Table VII, especially for those with marginal and adequate incomes, supports the hypothesis that mortality is related to health practices independently of income.

In order to make comparisons between health practice groups for physical health status and income level simultaneously, it was necessary to dichotomize all of the variables. In Table VIII within each physical health status group the differentials between those who followed good and poor health practices were maintained for low and high income levels, with the differentials between health practice groups for those with disability or chronic conditions being greater than the differentials between income groups. Differentials in the groups with symptoms or no complaints were less marked, and for women were impossible to evaluate because of the small number of deaths among those with poor health practices and low income.

Another method of adjusting for age, income level, and health status was used to examine the differentials between health practice groups. This method (11,21) makes no assumptions about the distributions of the variables and can be used on small numbers. In effect it adjusts the rate for one health practice group to the distributions of the other group on the independent vari-

TABLE IX
RATIO ADJUSTMENT OF MORTALITY RATES FOR PERSONS WITH POOR HEALTH PRACTICES TO THE DISTRIBUTIONS OF THOSE WITH GOOD HEALTH PRACTICES, FOR AGE, PHYSICAL HEALTH STATUS, AND INCOME LEVEL BY SEX

Rate	Men			Women		
	Health practices			Health practices		
	Poor[a]	Good[b]	P[c]	Poor[a]	Good[b]	P[c]
Number[d]	1012	1945		1156	2375	
Crude 5½-year mortality	.072	.052	<.05	.048	.041	<.34
Adjusted for age	.111	.052	<.001	.066	.041	<.001
Adjusted for age and physical health status	.098	.052	<.01	.057	.041	<.05
Adjusted for age and income level	.117	.052	<.001	.081	.041	<.01
Adjusted for age, physical health status, and income level	.107	.052	<.01	.058	.041	<.051

[a] Four or fewer good health practices.
[b] Five to seven good health practices.
[c] P value from Diff/$SE_{diff.}$ for the crude rates and from χ^2 on the adjusted rates.
[d] Those for whom income level was known.

ables. The results are summarized in Table IX. The crude mortality rate for men was 0.072 for those with poor health practices, compared with 0.052 for those with good practices, a difference which was more than twice its standard error. When adjusted for age by the Hankey-Myers method the rate for the poor health practice group increased to 0.111. Since income level and health status were both related to age, the addition of these variables to the adjustment changed the rates very little. For women the difference between the mortality rates of the poor and good health practice groups, which was not significant when compared on the basis of the crude rates, was increased when adjustment was made for age because a larger proportion of the older persons followed good health practices. The addition of physical health status to the adjustment lowered the differential slightly, while the addition of income level increased it. Income level, when added to physical health status and age, made no difference in the adjusted rate. The differential in mortality between good and poor health practice groups was maintained or widened when adjustment was made for age, physical health status, and income. Thus, our conclusion is strengthened that the observed relationship between mortality and health practices is independent of income and health status.

Expectation of Life

If we take the schedule of death rates by age, shown in Fig. 1, and assume that these represent the experience of groups of people who consistently follow the same pattern of health practices, this experience can be translated into a life table (7). We must bear in mind that the differences found in mortal-

TABLE X
AVERAGE REMAINING LIFETIME USING DEATH RATES OF THREE HEALTH PRACTICE GROUPS AND CALIFORNIA LIFE-TABLE, 1959–1961[a]

	Age	Number of health practices			California[a] 1959–1961
		0–3	4–5	6–7	
Men					
	45	21.63	28.15	33.08	27.56
	55	13.77	20.21	24.95	19.73
	65	10.61	13.71	17.41	13.31
	75	7.43	10.23	11.22	8.33
	85	6.47	5.82	5.04	4.93
	90	3.19[b]	3.19[b]	3.19[b]	
Women					
	45	28.58	34.08	35.84	33.14
	55	20.02	25.11	27.83	24.60
	65	12.35	17.30	19.87	16.73
	75	8.63	11.70	12.50	10.04
	85	4.63	7.50	7.61	5.46
	90	3.23[b]	4.31[c]	5.10[c]	

[a] State Department of Public Health, *Abridged Life Tables, California, 1959–1961*, September 1963, p. 9.
[b] Estimated from California life-table.
[c] Partially estimated.

ity rates are not related solely to differences in health practices but reflect all other variables which may be associated with health practices. Starting with age 45, which assumes that there were no differences in mortality by health practice before that age, and making the further assumption that beyond age 90 the expectation of life for each group is similar to that of the general population, we have obtained the results shown in Table X. Both of these assumptions minimize the differences shown in the table. The expectation of life for the California population is included for comparison.

The expectation of life (average number of years of life remaining) at age 45 for men in the zero to three health practice group was 21.6 years compared with 33.1 years for those in the six to seven health practice group. The magnitude of this difference of more than 11 years is better understood if we consider that the increase in the life expectancy of white men in the United States between 1900 and 1960 was only 3 years. The difference between the two health practice groups for women was less, a little over 7 years, the same as the increase found for white women in the U. S. between 1900 and 1960 (20).

SUMMARY

This paper has analyzed the relationship between mortality in a 5½-year follow-up of a sample of adult residents of Alameda County, Calif and physical health status, income level, and seven personal health practices. Mortality, as measured by age-adjusted rates, was more strongly associated with poor health practices than it was with physical health status or with income level.

Individual health practices showed small but fairly consistent differentials in the expected direction with mortality rates, and for the older age groups there was a striking inverse correlation between the number of health practices and the mortality level.

REFERENCES

1. ABELIN, T. Application of life table methods to results of epidemiologic follow-up studies on smoking and mortality. *Amer. J. Epidemiol.* **81,** 254–269 (1965).
2. BELLOC, N., BRESLOW, L., AND HOCHSTIM, J. Measurement of physical health in a general population survey. *Amer. J. Epidemiol.* **93,** 328–336 (1971).
3. BELLOC, N., AND ARELLANO, M. Record linkage by computer on a survey population (to be *Health Services Rep.* (in press).
4. BELLOC, N., AND BRESLOW, L. Relationship of physical health status and health practices. *Preventive Med.* **1,** 409–421 (1972).
5. BERKMAN, P. Measurement of mental health in a general population survey. *Amer. J. Epidemiol.* **94,** 105–111 (1971).
6. CARRINGTON, R. Analysis of mobility and change in a longitudinal sample. *Pub. Health Rep.* **85,** 49–58 (1970).
7. CHIANG, C. L. "Introduction to Stochastic Processes in Biostatistics," Chap. 9. Wiley, New York, 1968.
8. CHIANG, C. L. Standard error of the age-adjusted death rate. *Vital Statistics, Special Rep.* **47,** (1961).
9. CIUCA, A. Longevity and environmental factors. *Gerontologist* **7,** 252–256 (1967).
10. HAMMOND, E. C. Life expectancy of American men in relation to their smoking habits. *J. Nat. Cancer Inst.* **43,** 951–962 (1969).
11. HANKEY, B. F., AND MYERS, M. H. Evaluating differences in survival between two groups of patients. *J. Chronic Dis.* **24,** 523–531 (1971).
12. HAYBRITTLE, J. L. Cigarette smoking and the expectancy. *Brit. J. Prev. Soc. Med.* **20,** 101–104 (1966).
13. Human Population Laboratory. "Alameda County Population, 1965," p. 79, State of California Department of Public Health, Ser. A, No. 7, 1966.
14. KANNEL, W. B. Habitual level of physical activity and the risk of coronary heart disease: Framingham. *Can. Med. Ass. J.* **96,** 811–812 (1967).
15. LEMON, F. R., AND KUZMA, J. W. A biologic cost of smoking: decreased life expectancy. *Arch. Environ. Health* **18,** 950–955 (1969).
16. LETOUNOV, S. The importance of physical education and sports as preventive measures for healthy and sick persons. *J. Sports Med.* **9,** 142–151 (1969).
17. Metropolitan Life Insurance Company. Mortality among overweight men. *Statist. Bull.* **41,** 6–10 (1960).
18. Metropolitan Life Insurance Company. Mortality among overweight women. *Statist. Bull.* **41,** 1–4 (1960).
19. Metropolitan Life Insurance Company. "Overweight, Its Prevention and Significance" (1960).
20. Metropolitan Life Insurance Company. Progress in longevity since 1850. *Statist. Bull.* **44,** 1–3 (July 1963).
21. MYERS, M. H. "A Computing Procedure for a Significance Test of the Difference Between Two Survival Curves." Methodological Note No. 18 End Results Section, Biometry Branch, National Cancer Institute, February 1966.
22. National Center for Health Statistics. "Weight by Height and Age of Adults, United States, 1960–62," Ser. 11, No. 14, Washington D. C., 1966.
23. PALMORE, E. Longevity predictors, implications for practice. *Postgrad. Med.* **50,** 160–164 (1971).
24. PALMORE, E. Physical, mental and social factors in predicting longevity. *Gerontologist* **9,** 103–108 (1969).

25. PALMORE, E. Predicting longevity, a follow-up controlling for age. *Gerontologist* **9**, 247–250 (1969).
26. RENNE, K. Measurement of social health in a general population survey (to be published).
27. SCHMIDT, W. AND DE LINT, J. Mortality experience of male and female alcoholic patients. *Quart. J. Stud. Alc.* **30**, 112–118 (1969).
28. STANTON, B. R., AND EXTON-SMITH, A. N. "A Longitudinal Study of the Dietary of Elderly Women," King Edward's Hospital Fund, London (1970).
29. STEINKAMP, R. C., COHEN, N. L., AND WALSH, H. E. Resurvey of an aging population, 14-year follow-up. *J. Amer. Diet. Ass.* **46**, 103–110 (1965).
30. WALKER, A. R. P. Can expectation of life in Western populations be increased by changes in diet and manner of life? *South Afr. Med. J.* **42**, 144–150 (1968).
31. WEIR, J. M., AND DUNN, J. E., JR. Smoking and mortality, a prospective study. *Cancer* **25**, 105–112 (1970).