Cardiovascular Screening To Assess Risk of Coronary Heart Disease

JOSEPH T. DOYLE, M.D., SANDRA H. KINCH, M.S., and DAVID F. BROWN, M.D.

PROSPECTIVE studies, of which the Albany Cardiovascular Health Center study is typical, have confirmed or identified about a dozen characteristics which to varying degrees are associated with an increased incidence of cardiovascular disease (*1–8*). Such studies, however, are enormously expensive in terms of both service and research. An increasingly interested and informed public is now putting great pressure on health agencies to mount effective programs toward prevention of heart disease.

It is accordingly desirable to develop methods to identify and serially re-evaluate susceptible groups and, if possible, individual members of such groups. In 1961 we developed such a procedure by having nonmedical personnel conduct diagnostic examinations during the period between the regular biennial medical appraisals of the Cardiovascular Health Center population of men. This procedure, carried out by appropriately trained personnel and evaluated against the basic program, convinced us that complete and reliable information on cardiovascular risk factors can be obtained efficiently, economically, and with high acceptability by the participant. Therefore, we decided to extend this operation to a much larger group comprised of both men and women.

Dr. Doyle is professor of medicine, head of the subdepartment of cardiovascular medicine, and director of the Cardiovascular Health Center, Albany Medical College, Albany, N.Y. Mrs. Kinch is director of health statistics, office of biostatistics, New York State Department of Health. Dr. Brown is associate professor of medicine and associate director of the Cardiovascular Health Center, Albany Medical College. *This paper was presented at the Annual Conference on the Epidemiology of Cardiovascular Diseases in Chicago, Ill., February 4–5, 1967.*

Methods

The population selected for study was a logical extension of the Cardiovascular Health Center population—all civil service employees in the Albany area 21 years of age or over who had been employed by the State of New York for at least 2 years. As in the original project, the entire universe rather than a sample was chosen for study. It was estimated that this population numbered approximately 20,000.

The employee health service of the New York State Department of Civil Service enlisted the employees' cooperation in entering the program. Each employee received a brief description of the program and a participation card on which he indicated his willingness to participate. All persons who wished to participate were contacted by their personnel offices to schedule appointments. Examinations were performed daily by two nurse-technicians from 9 to 11 a.m. and from 1 to 3 p.m. Appointments were made at 15-minute intervals. Thirty examinations were scheduled daily. Separate sessions were held for men and women.

Before reporting for his appointment, the participant completed a questionnaire type of lifetime medical history distributed from his

personnel office. This questionnaire specially emphasized the cardiovascular and respiratory systems. The form was reviewed by the receptionist when the participant arrived for examination. Any misunderstandings were clarified and omissions were remedied at that time.

A conference room, about 30 by 40 feet, was used for the screening program. Reception and seating areas were set up at the entrance. Two dressing and two examining cubicles, fabricated from plywood, occupied the center of the room. A suitably shielded 70-mm. X-ray unit was installed in an outside corner. Men undressed to the waist and wore paper slippers. Women undressed to the waist, removed or rolled down their stockings, and wore paper examining gowns and paper slippers.

The examination sequence was as follows. In the examining cubicle a nurse-technician measured height (unshod) and weight on a platform scale. The screenees were lying down when systolic and diastolic (fourth and fifth phase) arterial blood pressure was measured as well as when the 12-lead electrocardiogram was recorded on a direct-writing instrument with a paper speed of 50 mm. per second. Venous blood was drawn through a disposable needle into a plastic disposable syringe. A 70-mm. chest film was taken. The participant then dressed and left a urine specimen in an adjacent lavatory. The examination procedure required an average of 15 minutes per person.

At the conclusion of the morning and afternoon sessions a microhematocrit reading was done, the specific gravity of the urine was measured by hygrometer, and urinary pH, glucose, and protein were measured by dipstick. At the end of the day, the clotted blood specimens were brought to the Cardiovascular Health Center laboratory where they were centrifuged and the supernatant serum was removed. Total serum cholesterol was measured on the AutoAnalyzer (*9*). Duplicate samples were analyzed to obtain an estimate of the technical error of the method. To determine comparability of the two methods, analyses of some samples were also made in the laboratory of the Cardiovascular Health Center using the Abell-Kendall method (*10*). The Abell-Kendall method yielded results 3 percent higher than the AutoAnalyzer. Serum triglycerides were measured for selected members of the population but are not reported here. All electrocardiograms were read by Dr. Doyle, according to the same criteria used in the Cardiovascular Health Center (*11*). All X-rays were interpreted by one physician assigned from the bureau of chronic respiratory disease, New York State Department of Health.

A report of findings was submitted to the personal physician designated by the screenee, and a warning of abnormalities was sent to the screenee.

Data were coded and the five punchcards generated for each patient were converted to disk records for processing on the IBM 1620 and to magnetic tape for processing on the IBM 7010.

Results

From February 1965 through mid-July 1966, 11,992 eligible persons from 22 departments and offices were contacted for examination. A total of 8,512 (71 percent) were actually seen in the screening center; 2,160 (18 percent) refused

Figure 1. Distribution of 8,512 participants in Albany, N.Y., cardiovascular screening program, by sex and age groups

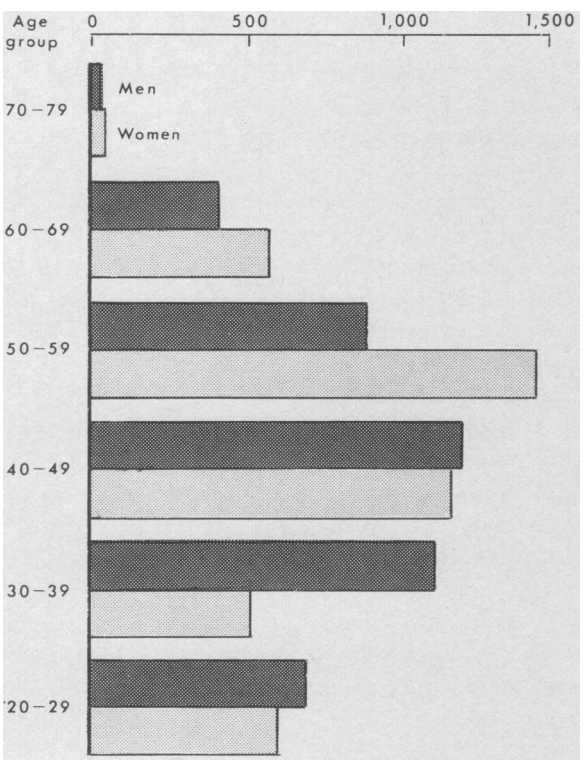
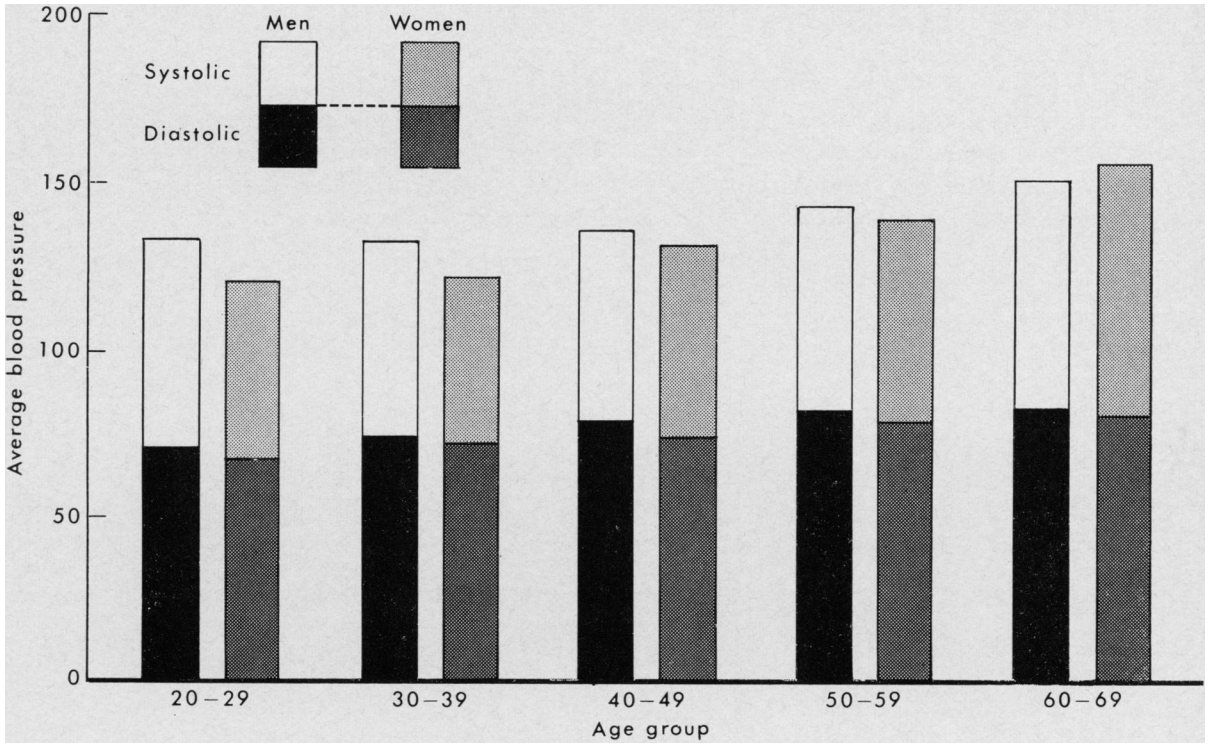


Figure 2. Average levels of systolic and diastolic blood pressure among cardiovascular screenees, by sex and age groups



to enter the program, and 1,320 (11 percent) deferred a definite response. Little publicity was given the program and no strenuous efforts were made to enlist participation.

Data are presented here for only a limited number of the total variables measured. Figure 1 shows the age-sex distribution of the population screened. There were 4,245 men and 4,267 women. The women were on an average 4 years older than the men. Almost half (48 percent) of the women were over 50 years of age, while fewer than a third (30 percent) of the men were this old. Only about half of the potential total group has been screened to date, thus the data may be biased in relation to the population seen. Publications of the New York State Department of Civil Service indicate that women comprise 39 percent of the total civil service population and that among those 21 years of age and over the average age is 43 years. Few other demographic data are available for the total civil service population. The average age for men in the civil service sample was 44 years. Women comprised 52 percent of the screened population and their average age was 47 years. The average age of male screenees was 43 years.

Twenty-nine persons, 23 men and six women, all over 40 years old, had definite electrocardiographic evidence of myocardial infarction; nine had no history of chest pain or of a heart attack.

Twenty-two men and 10 women had hypertensive heart disease manifested by hypertension according to the Princeton criteria and electrocardiographic evidence of left ventricular enlargement (*11*).

Figure 2 shows the average levels of systolic and diastolic blood pressure for each sex and age group. Systolic blood pressure tended to rise with age for both men and women. The differences between the sexes were greatest in the age group 20–29 years, where the systolic blood pressure in men was 135 mm. Hg., and in women 121 mm. Hg. In the age group 60–69 years, women had an average systolic blood pressure approximately equal to that of men, 153 compared with 151 mm. Hg. The variation in each age group was about the same for each sex.

Diastolic blood pressure followed the same pattern as the systolic pressure and rose with age in both sexes. In men 20–29 years of age diastolic blood pressure was 70 mm. Hg., and in the 60–69 year age group it was 81 mm. Hg. In comparable groups of women diastolic blood pressure rose from 68 to 80 mm. Hg. and did not exceed the male level in any age group.

Figure 3 shows the average total serum cholesterol levels by sex and age groups. The average level tended to increase with age in both sexes, although in men older than 40 years it remained more nearly constant while in women it continued to rise. After age 49, the level in women exceeded that in men.

Figure 4 shows the percentages of current cigarette smokers and ex-smokers by age and sex. The smoking categories used in this study are similar to those used in the Albany-Framingham reports (*12*, *13*)—never smoked, ex-cigarette smokers, cigar and pipe smokers, and current cigarette smokers. The proportion of women currently smoking cigarettes was greater than or equal to that for men in all age groups except the 60–69 year old group, where a higher proportion of men smoked cigarettes. The proportion of male ex-smokers was greater in all groups and rose with age. The proportion of men currently smoking was considerably less than in comparable age groups in the Cardiovascular Health Center in 1953.

Obesity, defined as the percentage over ideal weight by the Metropolitan Life Insurance Company (*14*), followed a pattern similar to that of the other variables, generally rising with age in both men and women (fig. 5). In all age

Figure 3. Average total serum cholesterol levels among cardiovascular screenees, by sex and age groups

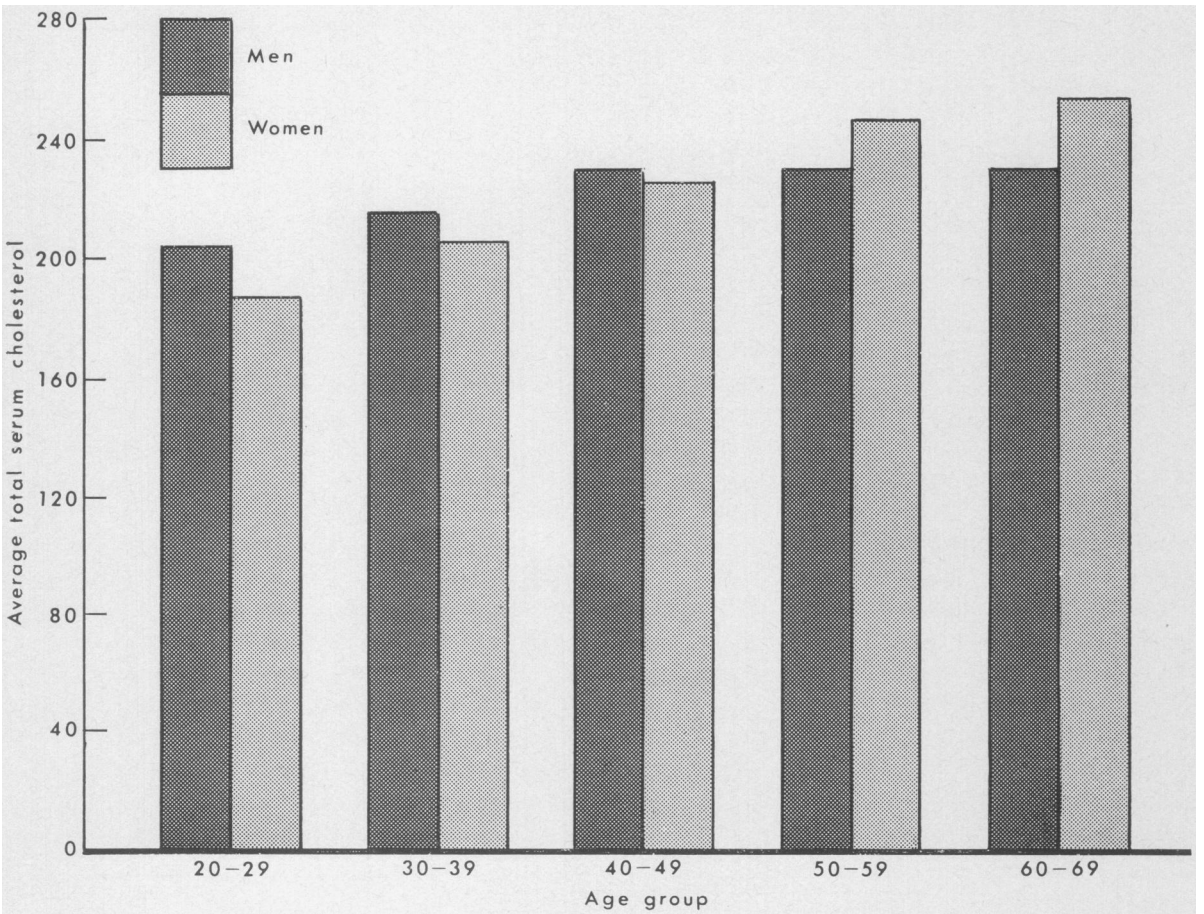
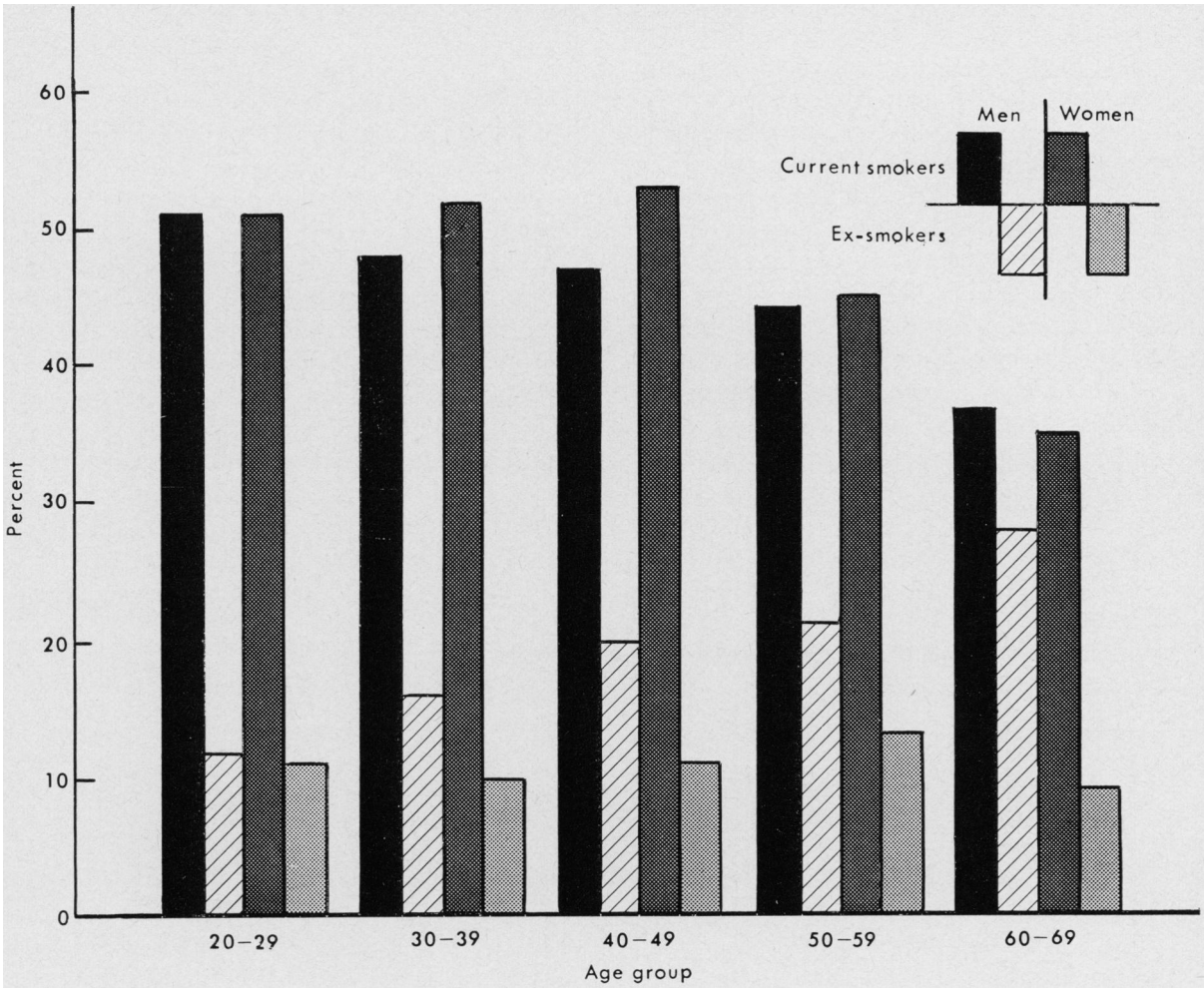


Figure 4. Percentage of current smokers and ex-smokers among cardiovascular screenees, by sex and age groups



groups, obesity was more prevalent among women. Differences in weight between the sexes increased with age.

The relationship between smoking and the variables of arterial blood pressure, total serum cholesterol, and obesity is of interest.

Blood pressure levels were similar in the three smoking groups—ex-smokers, cigar and pipe smokers, and current smokers—at each age level for both sexes. In each smoking group, blood pressure rose with age. The proportion with hypertension, as defined by the Princeton criteria, was similar in all three smoking categories for each age-sex group.

Up to 50 years of age the total serum cholesterol showed age and smoking effects in both sexes; that is, mean cholesterol levels rose with age in each smoking group and with smoking at each age level and were consistently higher in men than in women. The age effect was still apparent in women older than 49 years, but the apparent smoking effect was diminished. Cholesterol levels in women exceeded those in men in every age-smoking comparison after the age of 49 years.

Obesity tended to rise with age in each sex and in each smoking group. Current smokers of both sexes were less obese than ex-smokers or persons who had never smoked.

Table 1 shows the prevalence of the following risk factors: (*a*) cholesterol $\geqq$275 mg. per ml., (*b*) systolic blood pressure $\geqq$160 mm. Hg., (*c*)

diastolic blood pressure ≧95 mm. Hg., (*d*) obesity 135 percent or more of ideal weight, and (*e*) smoking of 20 or more cigarettes per day. Figure 6 shows the prevalence of the first four risk factors singly or in combination. Of the total population screened, 2,195 men (52 percent) and 2,114 women (50 percent) had none of these four characteristics; 35 percent of the men and 36 percent of the women had one risk factor; 10 percent and 11 percent respectively had two risk factors, and 3 percent of both sexes had three risk factors. Nine men and 11 women had all four risk factors. The most common risk factor singly or in combination was smoking. The higher prevalence of two, three, or four risk factors among women was partially related to the age distribution of the group inasmuch as the frequency of the other variables tended to rise with age.

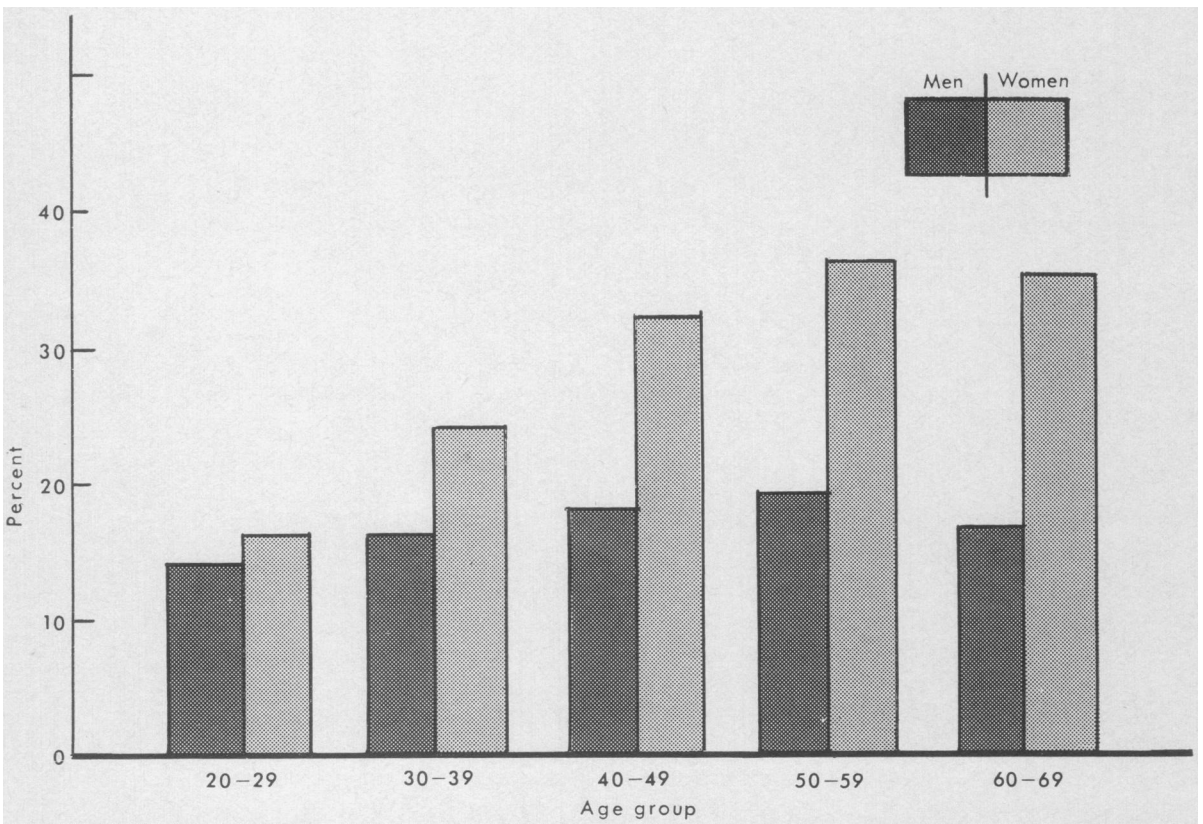
Table 2 shows the prevalence of the same risk factors shown in figure 6 in the population under 40 years of age. Three men and one woman had all four factors. One percent of each sex had three risk factors and 5 percent of the men and 2 percent of the women had two risk factors.

Discussion

Eighteen months' experience with a large cardiovascular screening program has shown this approach to the study of coronary disease to be feasible. The direct cost of the examination procedure was about $12 per person, while the indirect costs borne by the Cardiovascular Health Center can be only roughly estimated to have been an additional $8–$10.

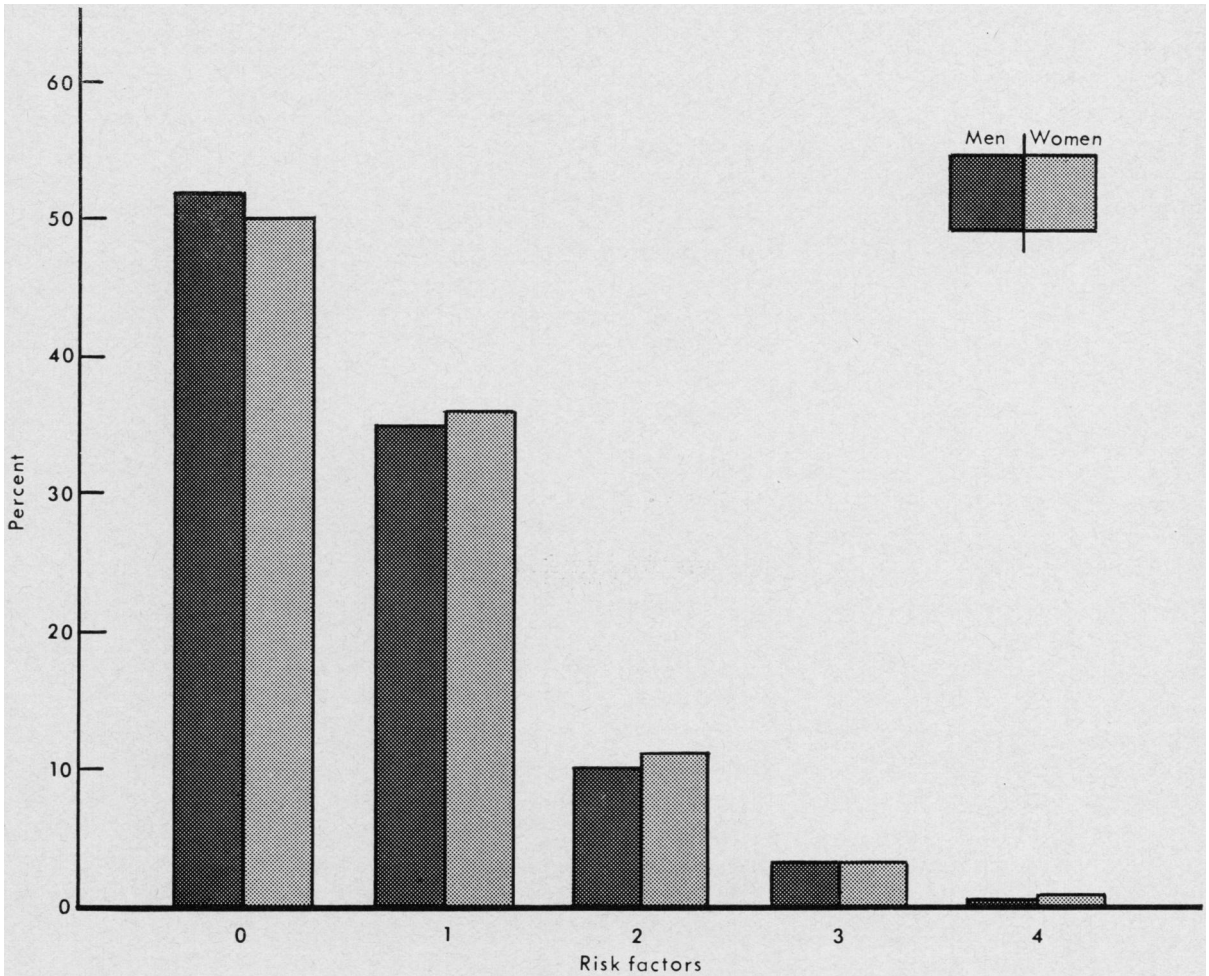
With a minimal recruiting effort, it was possible to enlist 71 percent of 11,992 eligible persons in the screening program. Of the remaining 29 percent, 18 percent definitely refused to participate while 11 percent indicated that they would probably enter at a later date. A strenuous campaign would very likely have substan-

Figure 5. Percentage of cardiovascular screenees who were obese,[1] by sex and age groups



[1] ≧135 percent of ideal weight by new Metropolitan Life Insurance Company standards; ≧122 percent of ideal weight by the company's old standards.

Figure 6. Percentage of 4 selected risk factors [1] among total population in cardiovascular screening program



[1] Cholesterol ≧275 mg. per 100 ml., systolic blood pressure ≧160 mm. Hg., diastolic blood pressure ≧95 mm. Hg., and smoking ≧20 cigarettes per day.

Table 1. Number of persons with risk factors in total population of cardiovascular screenees by age and sex

Age group (years)	Total screenees		Cholesterol [1]		Systolic blood pressure [2]		Diastolic blood pressure [3]		Obesity [4]		Smoking [5]	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Total	4, 245	4, 267	482	748	572	614	533	499	715	1, 316	1, 419	1, 270
20–29	682	581	30	14	42	11	21	11	95	94	247	186
30–39	1, 087	495	89	23	76	13	99	27	173	121	379	180
40–49	1, 197	1, 158	170	154	130	111	153	124	213	369	410	394
50–59	875	1, 475	131	377	197	288	180	227	167	535	286	403
60–69	404	558	62	180	127	191	80	110	67	197	97	107

[1] Cholesterol ≧275 mg. per 100 ml. [2] Systolic blood pressure ≧160 mm. Hg. [3] Diastolic blood pressure ≧95 mm. Hg. [4] Obesity ≧135 percent of ideal weight by new Metropolitan Life Insurance Company standards; ≧122 percent of ideal weight by the company's old standards. [5] Smoking ≧20 cigarettes per day.

tially increased the participation rate, because an intensive effort to obtain participation in the original Cardiovascular Health Center program achieved an affirmative response rate of 89 percent.

The co-existence of the Cardiovascular Health Center program unexpectedly diminished participation. A considerable number of men enrolled in the center declined to enter the screening program. Reliable prevalence estimates can be made, however, by combining Cardiovascular Health Center data with data from the screening program.

The screening program has produced data which are generally comparable with those obtained in the Cardiovascular Health Center program (*2*).

The age-specific levels of systolic blood pressure and serum cholesterol for both men and women in each age group were similar to those published for the Tecumseh population (*8*). The diastolic blood pressure showed similar age-sex trends, but was 7–10 mm. Hg. lower for all age groups in the Albany population.

The cigarette smoking data compared with the original Albany data suggest that cigarette smoking in men of all ages has decreased during the past several years (*12*, *13*). Few data on cigarette smoking in women are available. Estimates from the American Cancer Society studies (begun in 1959–60), supplied by Dr. E. Cuyler Hammond, on the frequency of smoking in women by age, were lower than the rates observed in our study. The estimates for men were more nearly similar.

Data obtained on multiple risk factors support the belief that combinations of several occur rarely in general populations such as the New York State civil service organization. The most common risk factor in this group was the smoking of 20 or more cigarettes per day. Since data from the Albany and Framingham studies suggest that the risk of coronary heart disease is lessened among ex-smokers, programs designed to reduce the risk of coronary heart disease should emphasize the elimination of cigarette smoking.

The incidence patterns of coronary heart disease among women in the next few years will be of particular interest in view of the great frequency of heavy cigarette smoking.

Table 2. Prevalence of 4 selected risk factors[1] among cardiovascular screenees under 40 years of age

Risk factors	Men		Women	
	Number	Percent	Number	Percent
None	998	57	673	63
One	661	37	372	35
Two	85	5	21	2
Three	16	1	6	1
Four	3		1	

[1] See footnote to figure 6.

A mail followup of the population screened has been started. Responses from this program supplemented by data from the State retirement system will be used to estimate changes in the cardiovascular status of the group.

Summary and Conclusions

During an 18-month period, February 1965 through mid-July 1966, 8,512 male and female employees of the New York State Department of Civil Service in Albany were seen in a cardiovascular screening program. Twenty-nine persons had electrocardiographic evidence of myocardial infarction, and 32 were diagnosed as having hypertensive heart disease.

Observations on the total serum cholesterol concentration, arterial blood pressure, body weight, and smoking habits were generally similar to those reported from other studies.

Estimation of prevalence of selected risk factors indicated that cigarette smoking is the most common. Fewer than 1 percent of the total group exhibited elevations of total serum cholesterol concentration, arterial blood pressure, and heavy cigarette smoking in combination.

Data useful in the assessment of the cardiovascular and risk factor status of large groups can be obtained relatively easily and inexpensively through screening programs. Such information is essential for the identification of individuals who may be eligible for programs designed to mitigate risk factors as well as for the evaluation of such efforts. A considerable number of persons will apparently support such programs and are, based on this experience, willing to participate in more extensive examination procedures.

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Natural Disaster Hospitals

Boxed units of emergency medical supplies and equipment are being positioned in areas where natural disasters frequently occur. When a disaster strikes, the unit can be loaded on a truck, rushed to the scene, and used to aid the victims. The units are called Natural Disaster Hospitals (NDH). The first NDH has been placed at Enid, Okla., because of the town's location in the tornado belt.

The NDH is one phase of the Public Health Service's program to provide emergency medical supplies, equipment, and services quickly and efficiently during a disaster. Packaged Disaster Hospitals (units of supplies and equipment necessary to establish a 200-bed hospital) and Hospital Reserve Disaster Inventories (30-day backup inventories of critical medical items for community hospitals) are phases already in operation. The NDH serves a need different from the other programs in that it is designed to operate as a short term medical facility for up to 24 hours.

In an emergency, the NDH can be quickly set up as a complete 50-bed unit which can be used by a hospital to expand its facilities or it can be arranged in a church, school, or other available building to serve the emergency needs of approximately 300 casualties. The unit is small—83 cases of supplies and equipment; it is lightweight—2¾ tons; it is mobile—can be transported in four station wagons or two pickup trucks. Transported to the disaster site, victims with slight injuries can be treated on the scene and released. Victims with grave injuries can be given essential treatment before being moved to permanent hospitals. If necessary, the NDH can provide surgery in the field.

The Public Health Service plans to position 24 additional NDH's in high-risk natural disaster areas this year. The first group will be placed in the Middle West in anticipation of the tornado season. The second group will be placed in the hurricane-prone areas of the coastal regions before fall.

Program Notes

Dramatic Drop in Infant Mortality

In the health message that President Johnson sent to the Congress on March 4, 1968, he pointed out that the infant mortality rate in the United States had dropped from 25.2 deaths per 1,000 in 1963 to 22.1 in 1967—a 12 percent decline in 4 years. In 1963, 100,000 infants died; in 1967, 80,000.

The success of maternal and child health programs in two cities demonstrates, however, the President said, that infant mortality can be reduced even faster. Because of modern medicine and a concentrated effort, the rate in Washington, D.C., fell 8.5 percent during 1967; in Chicago in the first 10 months of 1967, the rate dropped 15 percent.

Through the maternal and child health programs, the President pointed out, 300,000 women in the United States are now receiving family planning services, 390,000 receive maternity care, and 680,000 infants are getting the attention crucial to their later development.

Increase in Hospital Costs

Hospital costs per patient day rose to an average of $58.06 in calendar year 1967, a 15.4 percent increase over the 1966 average.

A 17.4 percent increase in payroll expense per patient day contributed to the cost rise. Increased utilization was another factor. Total admissions to community hospitals were up, as was the daily census, and the length of patient stay increased along with the number of outpatient visits. Among Medicare-age patients, admissions increased 5.1 percent in the last 6 months of 1967 over the same period in 1966.—*The Week for . . . Hospitals*, March 15, 1968.

Genetic Information Center

The Connecticut State Department of Health has established a genetic information center in its office of mental retardation. Its purpose is to aid the medical practitioner in treating genetic disorders and in counseling prospective parents.

The center offers the medical practitioner direct consultation, providing him with information on the inheritance of the disorder of concern so that he can counsel his patient on its risks and implications. The center also maintains an inventory of the diagnostic and treatment facilities in Connecticut and neighboring States.

Safeguarding Migrants' Health

Stringent new regulations safeguarding the health and safety of migrant farmworkers have been added to the New York State Sanitary Code. A new section also specifies certain responsibilities of migrant camp occupants.

The new provisions concern housing, beds, ventilation, electric outlets, heating, kitchen and washing facilities, first aid kits, and so forth.

Clean Streams Law

Minimum treatment requirements for more than 1,500 miles of rivers and streams in Pennsylvania will be upgraded as a result of the State sanitary water board's recent adoption of amended regulations to the State's Clean Streams Law.

The new amendments will require at least secondary degree treatment for all biodegradable wastes and an equivalent for industrial wastes.

Secondary treatment for all sewage and biodegradable industrial waste is now required for virtually all of Pennsylvania's 50,000 miles of rivers and streams.

Rural Nursing Assignments

Six nursing students in a pilot program in Pennsylvania will have the opportunity to study public health needs in a rural location. The opportunity is provided in a new public health nursing education program recently inaugurated in Pennsylvania by the health department and the State university. The program is designed to abate the critical shortage of nurses, particularly of public health nurses.

This rural public health assignment represents "an innovation in clinical assignment" according to Margaret L. Balog, assistant director, division of public health nursing.

Registered nurses who graduate from 3-year diploma programs have always been able to enroll in colleges or universities, Miss Balog said, but to qualify for advanced public health nursing jobs might require an additional 2 to 3 years. Through the straight Bachelor of Science in Nursing program, now offered at Pennsylvania State University, these qualifications can be met in a total of 4 years.

Detection of Food Poison

Direct detection of poisons produced by bacteria in food is now possible. Dr. Ezra P. Casman of the Federal Drug Administration's Bureau of Science recently described to the annual meeting of the American Society for Microbiology a new method he had developed. The method is technically simple and can measure as little as one part of toxin in 200 million parts of food. It has already been used by one firm to salvage all but approximately 60,000 pounds of 4 million pounds of suspect cheese.

To Help Mental Patients Adjust

A special project at Michigan State Hospital in Ypsilanti is showing how older, long-term mental patients can be returned to normal community life. Under the project, a therapy program has been established within special wards designed to approximate as much as possible community life and relationships.—*Aging*, March 1968.

Items for this page: Health departments, health agencies, and others are invited to share their program successes with others by contributing items for brief mention on this page. Flag them for "Program Notes" and address as indicated in masthead.
