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BLOOD PRESSURE LEVELS OF ACTIVE PILOTS COMPARED WITH  
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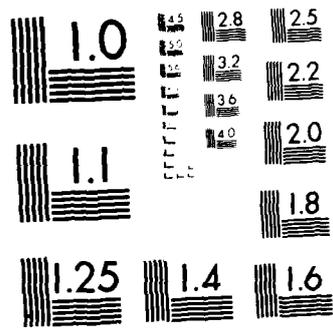
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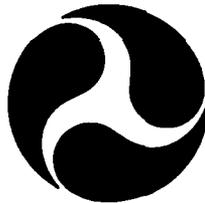
BLOOD PRESSURE LEVELS OF ACTIVE PILOTS COMPARED  
WITH THOSE OF AIR TRAFFIC CONTROLLERS

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<p>16. Abstract</p> <p>Currently some 15,212 active airmen are certified to fly with a diagnosis of hypertension. Federal Aviation Administration blood pressure standards for certification of airmen are considered to be quite liberal; however, recent FAA policy further liberalized medications and dosages allowed in certification of airmen.</p> <p>Since limited information is available concerning the recorded blood pressures of airmen, a systematic sample of active pilots was extracted from automated medical files maintained by the Aeromedical Certification Branch of the Civil Aeromedical Institute for descriptive purposes as well as to compare with a sample of air traffic controllers, given the continuing interest in the relationship of stress of air traffic control work. This is a pre-strike ATCS sample.</p> <p>Distributions of blood pressure by age were compared by using conventional non-parametric techniques for 10-year age intervals. Data were also compared with general population findings. Prevalence of hypertension is greater in the general United States population than found with any of the groups reported here.</p> <p>Prevalence of borderline and definite hypertension is seen to increase with age for all groups studied. Prevalence of any degree of hypertension is lower for airline pilots than either the all-airmen group or the air traffic controller group. Of the three airman groups, prevalence of hypertension is highest for the air traffic controllers, but the influence of more liberal waiver and retention criteria for air traffic controllers is an important reason for the excess.</p>			
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## BLOOD PRESSURE LEVELS OF ACTIVE PILOTS COMPARED WITH THOSE OF AIR TRAFFIC CONTROLLERS

### INTRODUCTION

Hypertension and related complications represent a significant public health problem in the United States today. Recent studies suggest that 18.1 percent of all Americans ages 18-74 years have definite hypertension, and another 18.2 percent have borderline hypertension.

Currently some 15,212 active airmen are certified to fly with a diagnosis of hypertension. Federal Aviation Administration (FAA) blood pressure standards for certification of airmen are considered quite liberal, and recent FAA policy with regard to allowable medications and dosages further liberalizes certification standards.

This study presents data pertaining to the prevalence of hypertension by age group for all airmen, airline pilots, and a sample of active air traffic control specialists (ATCS's) during 1980. Other pertinent comparisons are made with large-scale population studies.

### BACKGROUND

The Health and Nutrition Examination Survey (HANES) was designed to assess the general health and nutritional status of the United States population between the ages of 6 and 74 years (8). To achieve this goal, a probability sample of 24,513 persons representing the civilian, noninstitutionalized population was drawn by the United States Census Bureau. Nutritional and health data collection began in April 1971 and concluded in June 1974. Data were collected from 17,854 persons, an adjusted response rate of 74.4 percent.

The health examination included the indirect measurement of blood pressure with a sphygmomanometer. Three measures of blood pressure were taken with the subject in a seated position. Only the initial measurements, however, were used to calculate the prevalence of hypertension. Ninety-eight percent of the initial blood pressure measurements were taken by physicians. Definite hypertension was defined as either a systolic blood pressure greater than or equal to 160 mm Hg or a diastolic blood pressure greater than or equal to 95 mm Hg. Persons with a systolic blood pressure less than 160 mm Hg and a diastolic blood pressure less than 95 mm Hg, but not both a systolic blood pressure less than 140 mm Hg and a diastolic blood pressure less than 90 mm Hg, were classified as borderline hypertensive.

Blood pressure was found in this cross-sectional study to increase with age. Mean systolic blood pressure in males exceeded that of females until age 55, at which time the mean systolic blood pressure of females became greater. Mean diastolic blood pressure of males exceeded that of females throughout life. Black males and females, 25-74 years old, consistently had higher mean systolic and diastolic blood pressures than their white counterparts. Mean systolic and diastolic blood pressures varied inversely with the population density of the area of residence, education, and family income. Systolic blood pressure for males and females living in the southern United States, regardless of race, was found to be higher than that of persons living in the northeastern or western United States.

The overall prevalence of definite hypertension in adults, 18-74 years old, was 18.1 per hundred persons. The age-adjusted prevalence rates of definite hypertension for whites and blacks were 16.8 percent and 30.5 percent, respectively. Within the 18- to 74-year-old group, the prevalence of borderline hypertension was 18.3 percent. Interestingly, the age-adjusted prevalence of borderline hypertension was 18.5 percent for whites and 16.3 percent for blacks.

The initial Health and Nutrition Examination Survey was continued through 1975 with the intent of further examination of the health status of adults between the ages of 25 and 74 years (9). The probability sample consisted of 9,881 adults between 25 and 74 years of age. Data were collected on 6,913, an adjusted response rate of 70.7 percent. In this phase of the study, the three blood pressure measurements were averaged in an effort to account for the often labile nature of blood pressure. The previously described criteria for definite and borderline hypertension were used.

The findings of this portion of the HANES study were similar to those using only the initial blood pressure measurement. The overall prevalence rate in the 25- to 74-year-old group for definite hypertension was 18.0 percent. A prevalence rate of 17.1 percent was calculated for borderline hypertension.

The Community Hypertension Evaluation Clinics were conducted at 1,171 sites in 42 states from 1973 through 1975 (11). During this period, over 1 million volunteers were screened for hypertension. Single blood pressure measures, with the subjects in a seated position, were taken by trained volunteers or health professionals. Subjects who were found to have a diastolic blood pressure greater than or equal to 90 mm Hg or a systolic blood pressure greater than or equal to 180 mm Hg were referred to their family physician or another appropriate source of health care.

Prevalence rates were calculated by using two definitions of hypertension. The prevalence rate of hypertension defined as a diastolic blood pressure greater than or equal to 90 mm Hg was 24.68 percent. A prevalence rate of 11.56 percent was calculated by using a diastolic blood pressure greater than or equal to 95 mm Hg as the definition of hypertension. The all-volunteer study population may not be representative of the general population, and, therefore, inferences should be made with caution.

The Hypertension Detection and Follow-up Program was a community-based randomized clinical trial to assess the effectiveness of two forms of medical care for hypertension (5,12). To ascertain study subjects, 14 target areas were identified by using census tracts. A probability sample of 30- to 69-year-olds produced 178,009 subjects.

Between February 1973 and May 1974, 158,906 subjects completed the first screening. During the initial screening, three blood pressure measurements were taken with the subject seated by using a mercury sphygmomanometer. Hypertension at the first screening was defined as a mean of the second and third diastolic blood pressures in excess of 95 mm Hg. According to this definition, 22,978 of the 158,906 persons measured were hypertensive, a prevalence rate of 14.5 percent.

Several large regional studies concerned with hypertension and other risk factors associated with coronary heart disease have provided estimates of the prevalence of hypertension. One of the most well known is the prospective study of the residents of Framingham, Massachusetts. In 1949, 5,127 men and women between the ages of 30 and 62 years who were free of any evidence of coronary heart disease were entered into the study (6).

At entry into the study, three blood pressure measurements were taken with the subject in a seated position by using a sphygmomanometer. Only the initial measurement was used to characterize each subject's blood pressure status. Definite hypertension was defined as a blood pressure greater than or equal to 160/95. Persons with blood pressures ranging between 141/91 and 159/94 were considered borderline hypertensive. According to these definitions, 16.98 percent of the Framingham study population were hypertensive, and 34.6 percent were considered to be borderline hypertensive.

Limitations exist in use of the prevalence data from the Framingham population to make inferences to other populations. People with any evidence of coronary heart disease were not entered in the study population. In addition, only individuals between the ages of 30 and 62 years at the time of entry into the study were eligible.

In 1978 and 1979, the first Connecticut blood pressure survey was conducted to establish baseline prevalence rates of hypertension and the status of blood pressure treatment and/or control (4). The target population of the survey was Connecticut residents who were 18 years or older in 1978. A probability sample of Connecticut residents yielded 5,816 subjects, of whom 4,582 were interviewed and given blood pressure examinations.

Each subject was given a standardized questionnaire on hypertension treatment status, nutrition and smoking. Three blood pressure measures were taken during the interview by using the protocol of the Hypertension Detection and Follow-up Program (5). Hypertension status was determined by using the mean of the second and third readings. Definite hypertension was characterized as a systolic blood pressure greater than or equal to 160 mm Hg and/or a diastolic blood pressure greater than or equal to 95 mm Hg, or a report of current treatment with antihypertensive medications. Persons with a systolic blood pressure between 140 and 159 mm Hg and a diastolic blood pressure less than 90 mm Hg or a systolic blood pressure less than 160 mm Hg and a diastolic blood pressure between 90 and 94 mm Hg were termed borderline hypertensive.

The first Connecticut blood pressure survey found the overall prevalence of definite hypertension to be 14.02 percent and borderline hypertension to be 17.43 percent.

During 1975 through 1977, 250,000 Georgians, 25 years or older, were screened for hypertension (7). Hypertension was defined as a diastolic blood pressure greater than or equal to 95 mm Hg or a diastolic blood pressure less than 95 mm Hg, but current treatment with antihypertensive medications. Using this definition, the investigators projected a prevalence rate of hypertension for adult Georgians of 23.17 percent.

A survey was conducted in 1979 to estimate the baseline prevalence of hypertension in adult residents of California (2). A multistage probability sample of California households produced a sample of 8,353 persons 18 years or older. Interviews and blood pressure measures were completed on 7,774.

Three measurements of blood pressure were taken during the interview. The mean of the second and third measures was used to determine hypertensive status. A diastolic blood pressure greater than or equal to 90 mm Hg, a systolic blood pressure greater than or equal to 140 mm Hg, or, regardless of the blood pressure, a report of current use of antihypertensive medication were three of the criteria by which hypertension was defined. These definitions produced an overall prevalence rate of hypertension among California adults of 24.0 percent.

Several earlier studies of the prevalence and incidence of hypertension among pilots and air traffic controllers have resulted in somewhat mixed findings.

In a 1973 study of 4,325 air traffic controllers and 8,435 second class airmen, Cobb and Rose concluded that the prevalence of diagnosed hypertension was approximately four times higher among air traffic controllers than among second class (presumably aviation-occupied) airmen (3). Data for this study were obtained from automated records maintained by the Federal Aviation Administration, and criteria for ascribing a diagnosis of hypertension were systolic pressure greater than 140 mm Hg or diastolic pressure greater than 90 mm Hg as recorded on the most recent medical examination. Some licensing bias was observed, since proportionally fewer active air traffic controllers than second class airmen were denied medical approval. Rates for both groups were considerably lower than among the general population due to the screening effect; i.e., all were previously certified airmen.

Booze studied the morbidity experience of 28,086 air traffic controllers from 1967 through 1977 and concluded that the prevalence of diagnosed definite hypertension among controllers was lower than expected in comparison with other large-scale prevalence study findings--either general population, select geographic, or industry groups (1). While slightly more liberal criteria were utilized in the FAA study, Booze further concluded that the approximately three times higher rates of definite hypertension observed in the HANES and Framingham studies were not accounted for by criteria differences.

A 5-year clinical study conducted for the FAA under contract with the Boston University School of Medicine concluded that the prevalence of hypertension (both definite and borderline) among air traffic controllers was 1.5 times that of white males in the HANES study and that the prevalence of definite hypertension by HANES criteria was 1.6 times higher among air traffic controllers than men in the general population (10). Comparison with the Framingham study yielded a 1.5 times excess prevalence of definite hypertension among air traffic controllers. Criteria for diagnosis of hypertension in the Boston University study of ATCS's was either systolic greater than or equal to 140 mm Hg or diastolic greater than or equal to 90 mm Hg on two successive visits approximately 9 months apart.

Comparison of prevalence findings among the several studies published in recent years, although fraught with problems due to differences in diagnostic criteria, age, sex, and race composition of the study, and size-methodology consideration, still offers some clues to a better understanding of the epidemiology of hypertension.

#### METHODS

Computer records maintained by the Aeromedical Certification Branch of the Civil Aeromedical Institute were accessed to provide census data for all active airmen and airline pilots as of January 1, 1982. Since 1980, ATCS health records are no longer a part of the airman health data file unless the health controller is also a pilot; a 10-percent systematic sample of ATCS's active during 1980 was selected from the airman health data file for the study (2,407 ATCS's). The Professional Air Traffic Controllers Organization (PATCO) strike occurred in 1981, so this is a pre-strike sample. Prevalence rates were computed for borderline and definite hypertension according to the following criteria.

Definite hypertension was defined as either systolic pressure of 160 mm Hg or diastolic pressure of 95 mm Hg or more, or indication of medication for blood pressure control.

Borderline hypertension was defined as systolic pressure below 160 mm Hg and diastolic pressure below 95 mm Hg, but not both below 140 mm Hg systolic and 90 mm Hg diastolic.

Normotension is, therefore, both systolic pressure below 140 mm Hg and diastolic pressure below 90 mm Hg. These criteria are the same as those applied in the HANES and other studies.

The Guide for Aviation Medical Examiners specifies that blood pressure should be taken with the applicant in the seated position.

#### RESULTS AND DISCUSSION

The overall prevalence of hypertension among airmen and ATCS's is clearly less than results of other large-scale general population studies of recent years (see Table I). Combined rates for borderline and definite hypertension amounted to a prevalence rate of 16.8 percent for all airmen, 10.6 percent for airline pilots, and 21.1 percent for air traffic controllers. Similar general population prevalence from the 1971-74 HANES was 36.4 percent. Prevalence of borderline hypertension for all airmen and the ATCS group closely approximates the findings of HANES with prevalence rates of 14.8, 16.7, and 18.3 percent, respectively. As would be expected in a screened population, prevalence of definite hypertension is considerably less for all categories of airmen than for the general population. The airline pilot group prevalence rates are, of course, considerably less than those for all airmen or ATCS's due to vigorous prescreening out of potential cardiovascular risks by airlines, probably greater health consciousness among airline pilots, and more rigorous FAA medical standards pertaining to airline pilots.

Prevalence rates for ATCS's are consistently and uniformly higher than for other airman categories studied. Earlier studies by Cobb and Rose, and Rose et al., found a higher prevalence of hypertension among controllers, presumably due to "job stress" experienced by ATCS's. Some speculation also exists regarding the propensity of the typical ATCS personality type to higher blood pressure.

Considerable interest has, of course, evolved recently concerning the so-called stress of ATCS work in the wake of the August 1981 air traffic controller strike.

Based on more liberal retention and waiver criteria for ATCS personnel, the higher overall prevalence findings among this group are to be expected. Certainly airline pilots and the all-airmen group are not relevant comparisons with the combined overall prevalence data for ATCS's. The combined overall prevalence rate of 21.1 percent for ATCS's is significantly less than the combined rate of 36.4 for the general population, mainly due to a lower prevalence of definite hypertension among ATCS's than among the general population.

The most relevant comparison between airman and ATCS groups studied and the HANES findings is with respect to the prevalence of borderline hypertension. Again, airline pilots have a much lower prevalence rate than either the all-airmen groups or ATCS's. However, rates for all-airmen, ATCS's, and the HANES population are more comparable; e.g., 14.8, 16.7, and 18.3 percent, respectively. Significant differences at the 0.05 level are, however, observed for the difference in rate between all-airmen and ATCS's, and all-airmen and HANES general population data. No significant difference in the rates between ATCS's and the HANES general population rate is observed. Age adjustment does not affect conclusions based on crude rate analysis.

Prevalence of borderline and definite hypertension is seen to increase with age for all groups studied, consistent with expectations. However, as seen in Figure 1, all groups increase at increasing rates with age, and the highest increases are seen for the ATCS group. It should be recognized, however, that the number of observations above age 60 among the ATCS group is small. The potential for artifactual influence due to small numbers should be considered.

SUMMARY

Prevalence of hypertension, either borderline, definite, or total, is lower for airline pilots than for either the all-airmen group or the ATCS group. It is higher for the general United States population than for any of the groups reported here.

Prevalence of hypertension is higher for the ATCS group than the all-airmen group, most likely due to more liberal waiver and retention criteria for ATCS's.

Prevalence of borderline hypertension is similar for the ATCS group and the general United States population.

TABLE I. COMPARISON OF HYPERTENSION PREVALENCE

STUDY GROUP	Borderline Hypertension 140-159 and/or 90-94		Hypertension 160 and/or 95		TOTAL (Borderline & Hypertension)	
	Freq	Percent	Freq	Percent	Freq	Percent
ALL Airmen	112,566	14.8	15,043	2.0	127,609	16.8
Airline Pilots	4,162	9.9	321	0.8	4,483	10.6
ATCS's	403	16.7	105	4.4	508	21.1
U.S. Population*		18.3		18.1		36.4
<u>Age Adjusted</u>						
ALL Airmen		14.8		2.0		16.8
Airline Pilots		9.5		0.6		10.1
ATCS's		18.4		5.5		24.0
U.S. Population		18.5		16.8		35.3

\*1971-74 Health and Nutrition Examination Survey

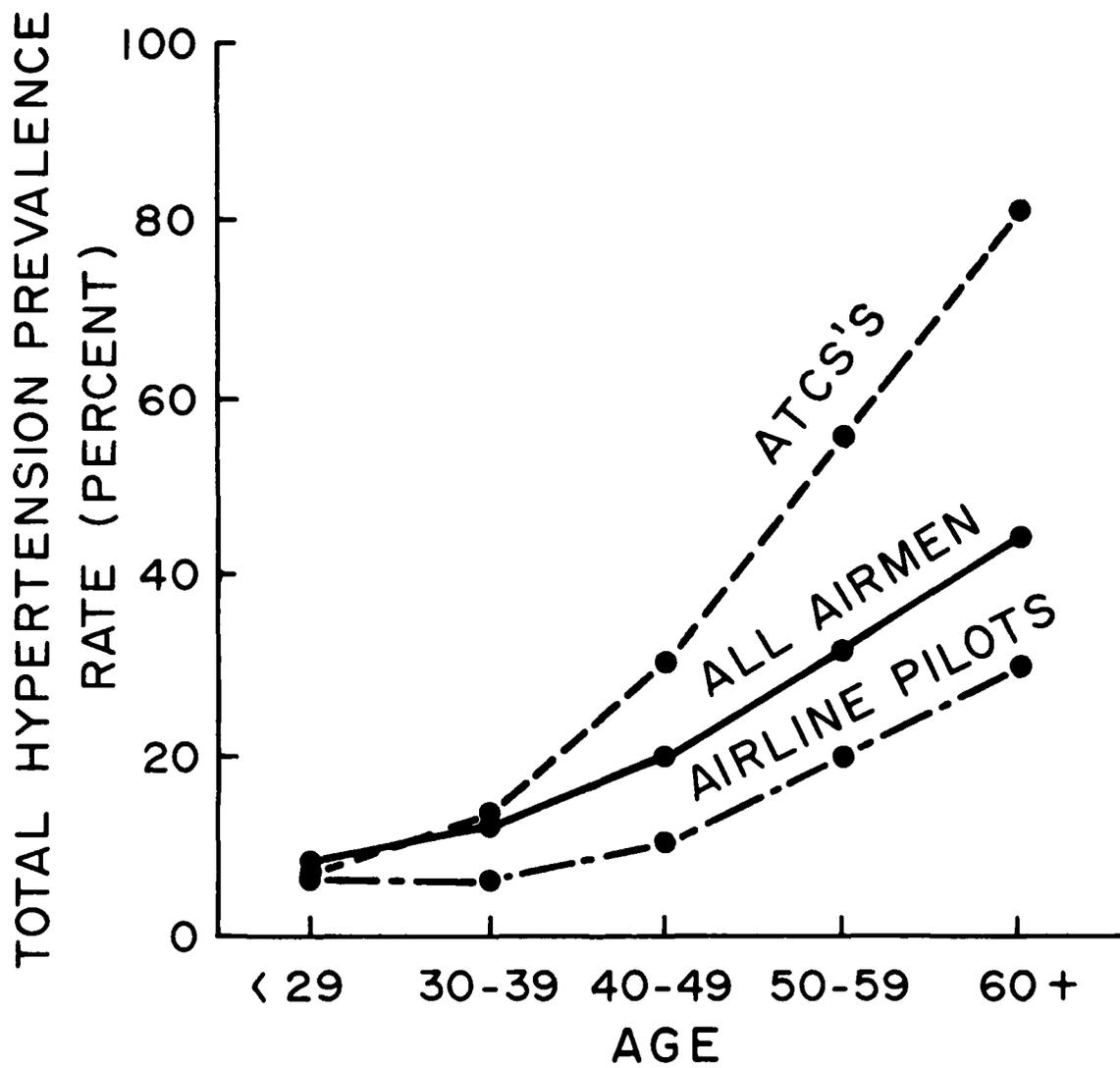


Figure 1. Prevalence of hypertension by age and group studied.

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