EXCESSIVE PROPORTION OF DISABILITIES AMONG AIRLINE PILOTS AND NAVIGATORS DUE TO CARDIOVASCULAR DISEASES: A SURVEILLANCE LEAD

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ABSTRACT

We tested the hypothesis that an excessive number of white male airline pilots and navigators suffer cardiovascular disability (CVD) as compared to the general white male population of the United States using data from the Social Security Administration's Disabled Worker File. We found that 185, or 63%, of the 293 disability allowances to airline pilots were for CVD; by contrast only 209,371, or 31% of 674,796, allowances in the general population were for CVD (proportional morbidity ratio = 2.04; p less than .001). These results are supportive of the a priori hypothesis that airline pilots have high job stress which initiated the analysis. Since they may be consistent with other explanations as well, additional research is needed. A posteriori speculation suggests that increased frequency of physical examination, the need for pilots to meet legally mandated standards of cardiovascular fitness more stringent than those applied to the general population, and other possibilities, discussed in the paper, may also contribute to or account for the excess. The finding of excess CVD among airline pilots consitutes a surveillance lead. Such leads demand etiologic followup through other investigations.

Introduction

Cardiovascular diseases (CVD) are among the ten leading work-related diseases and injuries published by the National Institute for Occupational Safety and Health (NIOSH)[1]. Psychological and physical stress have been hypothesized as being among the causes of cardiovascular disorders.[2] Psychological job stress has been associated with airline piloting.[3] Physical job stress also has been associated with aviation in general.[4] However, research comparing airline pilots directly with non-airmen appears to contradict the notion of stress causing cardiovascular diseases or the association of stress with avaitors. Indeed, the research of MacIntyre and his colleagues[5] provides support for the widespread belief that these airmen are almost supermen because their bodies, amazingly, appear virtually unaffected by the rigors of flying. Those researchers suggest that pilots' favorable socioeconomic background, genetic influence, intelligence, lifestyles (e.g. lower smoking rates), health and fitness all contribute to increased general good health and longevity. Non-airmen have not been characterized by these factors, and they appear to have more CVD than persons who could qualify as airmen. Thus, if a cardiovascular effect due to job stress exists, it most likely would be masked and difficult to detect by comparing the tendency among airmen to have CVD to the corresponding tendency of non-airmen. It is interesting to note that the rigorous pre-employment screening may remove the "canaries", as they are commonly referred to in occupational health - those who would succomb quickly to the stresses of airline aviation and give an early warning of the actual high risk, if it exists. An analysis is presented below which was unaffected by this difficulty and yielded results consistent with the job-stress hypothesis.

Background

If a cardiovascular condition exists, the in-flight stress, say from an emergency, could trigger incapacitation. Aviation officials have adopted policies to make it unlikely a cardiovascular disorder could cause an airline accident. The results of these policies are impressive: There has been no airline accident in the U.S. attributable to a cardiovascular disorder of the crew in the past 16 years[6]. As a part of the policies, airline pilots' and navigators' cardiovascular systems are monitored closely at routine physical examinations to reduce the chances of incapacitation during flight. The airline pilot or navigator can be "grounded" if any cardiovascular disorders are found. Dark and Davis[7] report that cardiovascular conditions accounted for 39 percent of all denials of medical certificates (i.e., medical groundings) among airline pilots in calendar years 1975 and 1976. After grounding, some aircrew may be employed in new jobs which have less stringent cardiovascular requirements. However, some may become so disabled that they are no longer able to be employed in any job.

U.S. airline pilots and navigators are eligible for Social Security Administration (SSA) disability benefits if they become so disabled that they cannot work. NIOSH uses a sample of the SSA file of disability allowances in

its occupational health surveillance activities. The files for calendar years 1975 and 1976 have data on white men who were airline pilots or navigatorsprior to their disability benefit allowance. These data were analyzed statistically to test a prediction from the hypothesis that job stress has caused cardiovascular disorders among airline pilots and navigators, namely that airline pilots and navigators are disproportionately disabled from CVD as compared to other workers.

More succinctly, this study was motivated by the following chain of four hypotheses :

(1) Airline pilots have high job-related stress.

(2) High job stress causes high cardiovascular disease.

Thus, (3) Airline pilots have high cardiovascular disease.

Therefore, specifically,

(4) Airline pilots receive a disproportionately high number of Social Security disability allowances due to cardiovascular disease.

The analysis directly puts (4) to test. The positive results, described below support (4) and, indirectly, the other three hypotheses which puts the whole superman notion in jeopardy.

Data and Methods

NIOSH has published[8] a description of the disabled worker file and procedures developed to analyze it. The SSA disability allowance file contains data from a stratified 20 percent probability sample of all SSA disability allowances. The 1975-76 portions of the file contain the age, sex, race, occupation and industry of 675,538 white male workers granted disability allowances during those years. To be eligible for a disability allowance "...a worker must be unable to engage in any substantial gainful activity due to a physical or mental impairment..."[9] The disorders causing the impairment must have lasted, or be expected to last for at least 12 months or will result in death.[9]

The cause of the disability is coded with the International Classification of Disease, Eighth Revision Adapted, ICDA-8.[10] Cardiovascular disorders were identified by Diseases of the Circulatory System (ICDA codes 390-458). Occupation and industry codes for each person in the file refer to the longest employment in the 10 years preceeding the application for an disability benefits. Occupation is coded according to the Dictionary of Occupational Titles, DOT[11], and industry with the Standard Industrial Classification Manual, SIC.[12] The 293 airline pilots and airline navigators who received disability allowances were identified by cross classifying Airplane Pilots and Navigators (DOT code 196) with Air Transportation Certified Carriers (SIC code

451). Since the codes used for airline pilots are also used for airline navigators, the data for the two groups of airmen are confounded in the sample. Modern navigational aids have eased the burden of navigation so much that navigators are not needed as much as in the past. Few if any navigators are employed by airlines today, but some were employed during the 1970's, mainly for overseas flights. Thus some navigators may be in the group analyzed. However, it is the opinion of the authors that pilots constitute the majority of this group because there were so few navigators employed. Moreover, this quandary may not affect the interpretation of the results because job similarities may allow inferences about stress for one group to be credibly applied to the other. Only white men were considered because there were too few black or female aviators in the sample to yield a meaningful analysis of either of these groups.

An estimate of the age adjusted proportional morbidity ratio (PMR) was used to study the association between airline pilots and navigators and CVD. The age intervals used were less than 40, 40-44, 45-49, 50-54, 55-59, 60-64, and over 65. More explicitly, the PMR for the airline pilots and navigators in this study is the ratio of the age-adjusted observed number to the age-adjusted expected number of disabilities calculated under the assumption that there is no association between the number of airline pilot or navigator cardiovascular disability allowances and their jobs. The mathematical formula for the PMR, without adjusting for age, is (a/b) / (c/d); where a = number of cardiovascular disability allowances to airline pilots and naviagtors, b = the total number of disability allowances granted to airline pilots and navigators, c = the total number of cardiovascular disability allowances for all occupations in the file, and d = total number of disability allowances in the file for all occupations. The more complicated age - adjusted PMR is a counterpart to this PMR when there is a need to adjust for age. However, both types of PMR's were calculated in this analysis and found to be approximately equal which implies that age-adjustment was unnecessary for the purpose of this paper. Thus, the results can be more easily conceptualized using the simpler formula, which does not adjust for age. Note the PMR does not compare an estimate of the cardiovascular disability incidence rate for the airmen to the corresponding rate for non-airmen. Instead, it compares the proportion of the airmens' disabilities which are cardiovascular to the same proportion for all disabled workers. Thus, the generally good health of the airmen would not have the masking effect it would have if the incidence rates of cardiovascular disabilities for airmen and nonairmen were directly compared.

The calculated PMR was used to estimate the corresponding national PMR value and is subject to sampling error. Therefore, a one-tailed t-test, at the .05 probability level, was used to test the null hypothesis that the national PMR was no greater than unity. A national PMR of no greater than unity means that the cardiovascular proportion of the disabilities was no greater for airline pilots and navigators than it was for all other workers. If the PMR was significant the alternate hypothesis was accepted. The alternate hypothesis was that the PMR was greater than unity, which implies that the national cardiovascular proportion was greater for airline pilots and navigators than it was for all other workers.

Results

The age-adjusted cardiovascular disability PMR for airline pilots and navigators was estimated to be 2.04 for 1975-76. This was significant (in fact, the achieved significance level, p was less than .001). The standard error of the PMR was .20. Thus, while cardiovascular disorders disabled about 31 percent of the 675,538 disabled white male workers, those conditions disabled more than 63 percent of the disabled airline pilots and navigators. Subsequent analyses found that the airline pilots and navigators' PMR's for heart and hypertensive disease (a disease catagory within the cardiovascular disorder catagory) and for ischemic heart disease (a disease category within the heart and hypertensive disease category) were, respectively, 1.99 and 2.28. In both cases these PMR's would have been significantly greater than 1.00 if these effects had been specifically hypothesized before examining the data.

Discussion

The finding here was that the PMR for airline pilots and navigators for CVD for all SSA disability allowances for 1975-76 was greater than 1. This, in turn, implies that cardiovascular disorders accounted for a disproportionately high number of the disabilities of airline pilots and navigators as compared to the disabilities of other workers.

The customary interpretation of a significantly high PMR like this is that the disorder was occupationally related but not necessarily occupationally caused. There were several possible causes of the high PMR, any combination of which could have caused a high PMR:

(1) Factors which are associated with the occupation of airline pilots or navigators but which are not intrinsically occupational.

(2) Something job-related minimizes the severity of many of the non-cardiovascular disorders.

(3) Because of the required physical examinations, the cardiovascular disorders of airline pilots and navigators are diagnosed earlier in the disease when treatment can best prolong life.

(4) Something job-related (like stress) causes increased cardiovascular disorders.

Under possibility (1), there are many factors which might be associated with the occupations of airline pilots and navigators, which are not intrinsic to the occupation itself. These include factors related to the pilot-navigator employment screening processes, the attraction of persons with special personal or physical attributes to the occupation, the lifestyles developed by pilots, special treatment of pilots by their employers or others, etc. Such exogenous factors might produce the empirical association described above if they are sufficiently related to both CVD and to persons who are pilots.

An example of a possible factor associated with the employment screening process would be a tendency not to employ those who have heavy smoking habits or a potential to contract non-cardiovascular diseases. Another possibility is that the rigorous selection of the pilots and navigators for airline employment may select persons with greater longevity even in the presence of a disabling cardiovascular condition. It is interesting to note that Hoiberg[4], in a study of morbidity among Navy pilots and other Navy aircrew members, found that the hospitalization rate for cardiac arrhythmia was greater than the corresponding rate for non-flying (line) officers who had a comparable employment screening process. Although the rigors of naval aviation are not comparable to the rigors of airline aviation, the employment screening process of its flying officers is comparable. Since the rate was higher for the Navy fliers, Hoiberg's study furnishes some indication that the employment screening process may not have been creating a misleading artifact in this airline study.

The occupation of pilots might be relatively more attractive to persons with personality characteristics which could increase the risk of CVD even if they had not become pilots. A possible factor is an attitude which leads to lack of concern about the future consequences of present activities on health. The lifestyle factor of smoking is well known to be highly associated with higher risk of CVD. Thus, if the airline pilots in this study smoked more heavily or more frequently than other workers, then this could produce the high PMR found in this study. However, the authors have not found any evidence that these pilots smoked more than other workers. In fact MacIntyre et. al. (5) site evidence of the opposite, i.e., reduced smoking by pilots and navigators. Moreover, if pilots and navigators did smoke more than other workers it would be difficult to understand why other researchers have not found higher CVD rates for pilots relative to other workers.

An example of the special treatment of pilots is the rigorous monitoring of the health of pilots, especially the condition of their circulatory system. This could lead to increased detection of cardiac abnormalities, even those which do not markedly impair the work of most other workers. If such increased detection does occur and if it results in more airline pilots applying for and receiving SSA disability benefits, it could produce the high observed PMR.

Under possibility (2) an example of something minimizing the severity of non-cardiovascular disorders would be a tendency for airline pilots to have only catastrophic accidents which kill rather than disable. Another is that they do not develop the cancer like other socio-economic groups.

Possibility (3) allows for the frequent thorough physical exams given to airline pilots and navigators by highly qualified medical specialists which attempt to detect and clearly diagnose cardiovascular abnormalities early. This may improve the likelihood that airmen have early diagnosis and subsequent treatment of a clearly understood abnormality and, therefore, less chance of a rapid deterioration of health. This, in turn, may result in higher proportions of airline airmen with CVD becoming disabled rather than dying from the disease.

While the results of this study were predicted by the hypothesis that airline pilots have greater job stress, and consequently, that hypothesis is supported by these results, other interpretations - both those discussed here and others - have not been discredited. Any of the exogenous factors just described could increase the prevalence of CVD disabilities. In addition, workers in occupations requiring more strenuous work than aviation may have lower risk of CVD than pilots and navigators (see reference 13, for example). Thus, additional research must investigate those possibilities before the stress hypothesis can have great scientific credibility.

Conclusions

The disabled workers file was used to test the hypothesis that the proportion of CVD awards for white male airline pilots and navigators was the same as the proportion of CVD disability allowances for the general population of workers. The data do not support this hypothesis. The population of disability allowances attributed to CVD for the white male airline pilots and navigators was 63% which was significantly greater than the 31% for white male CVD allowances in the general work population covered by Social Security benefits.

While the results are supportive of the a priori hypothesis that airline pilots have job stress, they may be consistent with other explanations as well. Additional research is needed. The finding here should stimulate additional research.

Recommendations

The qualifications mentioned in the discussion section above, prevent conclusive findings. Therefore, the authors recommend further study of the variables which caused the qualifications. The authors, additionally, recommend research about the measurement, effects and prevention of job stress. Credible CVD rates are also needed for airline pilots as well as other members of airline aircrews.

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