AN EPIDEMIOLOGIC STUDY OF SUDDEN DEATH AT WORK IN AN INDUSTRIAL COUNTY, 1979–1982

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The descriptive epidemiology of sudden death at work was studied in an urban, industrial county. County coroner's records were used to identify the 212 deaths that occurred at work among employed white males in Allegheny County, Pennsylvania in 1979–1982. Occupations and industries with increased risks for either sudden natural deaths or fatal injuries at work were identified by comparison with the white male county employed population. Men employed in service occupations had the highest age-adjusted sudden natural death rate at work (27.0 per 100,000). This was 2.5 times as high as the overall county rate. Men employed in the construction industry had the highest age-adjusted rate of fatal injuries at work (24.3 per 100,000). This was 4.4 times as high as the overall county rate. Twenty-five per cent (17/68) of occupational fatalities involved multiple fatalities or injuries. Only 1 per cent (2/144) of natural deaths at work and 7 per cent (5/68) of fatal injuries had blood alcohol levels exceeding 0.1 mg/ 100 ml, the level of intoxication. Improvements in the prevention and surveillance of sudden deaths that occur at work are suggested. Coroners' records are suggested for use in future surveillance on sudden deaths at work because they identified more sudden deaths at work than death certificates did.

accident prevention; accidents, occupational; cardiovascular diseases; death, sudden; death rate; occupations; toxins

Although work-related morbidity and mortality have been extensively studied, few studies have been carried out on deaths that occur at work. Because these deaths usually occur before age 65 years, and are acute in nature, they are often sudden, witnessed, and autopsied. Detailed information about deaths at work is usually available in coroners' records; they represent a central source of information for the identification of potential work-related factors.

Sudden deaths that occur at work may be separated into two categories: fatal injuries and natural deaths, i.e., deaths not due to injuries. Sudden cardiac death due to coronary heart disease is the more com-

mon cause of natural deaths which take place at work. Sudden cardiac death is the leading cause of death among middle-aged men in the United States (1). Fatal injuries are the fourth leading cause of death in the United States (2), and are the leading cause of death from ages 1 to 44 years (3).

Potential chemical exposures that might precipitate cardiovascular deaths in the workplace have been identified in previous studies (4). The presumed or suspected pathologic mechanisms associated with specific cardiotoxic chemicals are listed in table 1. Occupational exposures may be important precipitants of sudden heart attacks, although our study was not designed to identify specific exposures. The chemicals and occupations that have been associated in epidemiologic studies with increased mortality from various forms of cardiovascular disease are presented in table 2.

Published epidemiologic studies of fatal injuries are sparse, even though fatal injuries are the fourth leading cause of death in the United States (2). The highest worker injury death rates occur in the smaller industries, mining and quarrying, agriculture, and construction (2). Previous investigations of fatal occupational injuries have included collections of reported cases and tabulations of state or national statistics, based on dissimilar case definitions and various data sources (5). Autopsy data have not often been included.

The purpose of our study was to describe the demographic, occupational, and toxicologic characteristics of all deaths that occurred at work from 1979 through 1982 in Allegheny County, Pennsylvania. A second purpose of the study was to obtain numerator data for rates to identify high-risk occupations and industries where a subpopulation of workers might be at risk of catastrophic medical events.

MATERIALS AND METHODS

Allegheny County, Pennsylvania encompasses the city of Pittsburgh and its envi-

rons. The study population included all sudden deaths that were reported to the county coroner as having occurred at workplaces located within Allegheny County.

It was not possible to determine if all sudden deaths that occurred at work in Allegheny County were referred to the county coroner. However, this coroner's office has aggressively encouraged awareness and enforcement of the county regulations among county medical personnel, police officers, and funeral directors. Persons who became ill at work, went to hospital, and died longer than 24 hours later were probably excluded from reporting requirements. This loss of reported events could not be evaluated because of the difficulty of identifying sudden non-traumatic deaths at work from death certificate data only. However, potential selection bias was evaluated for the fatal injuries at work by comparison with vital statistics records for Allegheny County. A listing was obtained from the state vital statistics tape of all death certificates which indicated fatal occupational injuries during the study years. This listing was compared with our listing of fatal occupational injuries identified through the county coroner's records. The death certificates listed were obtained. The death certificates identified only 57 per cent (39/68) of the occupational fatalities reported to the office of the county coroner. No fatal injuries were identified from death certificates which were not also reported to the coroner. Coroner's records in this county were therefore inferred to be more accurate than death certificates for identifying occupational fatalities.

A sudden death at work was defined as a death where the fatal process began with symptoms or injury at work and ended in a death reported to the county coroner, usually within 24 hours. Symptoms were defined as those stopping the worker's usual activity. Work was defined as paid employment. All reported deaths at work in the county which occurred from January 1, 1979 through December 31, 1982 were in-

TABLE 1

*Exposure to occupational cardiotoxins reported in epidemiologic studies or case reports**

Chemical	Presumed or suspected mechanism				
	Coronary artery spasm	Accelerated coronary artery disease	Cardiomyopathy	Arrhythmia	Other
Fluorocarbon 22				Speizer et al., 1975 (46)	
Fluorocarbons 11, 12, 114				Valic et al., 1977 (47)	
Carbon monoxide		Stern et al., 1980 (34) DeCouflé et al., 1977 (35) Hernberg et al., 1976 (36)			Aronow and Isbell, 1973 (57) Anderson et al., 1973 (58)
Nitroglycerin	Lange et al., 1972 (31) Lund et al., 1968 (32) Carmichael and Lieben, 1963 (33)	Reeve et al., 1983 (37) Hogstedt and Andersson (38)			
Solvents Carbon disulfide		Tiller et al., 1968 (39) Tolonen et al., 1975 (40) Hernberg et al., 1973 (41) Nurminen et al., 1982 (42)			
Perchlorethylene				Abedin et al., 1980 (48)	
Benzene				Tauber, 1970 (49) Kleinfield and Tabershaw, 1954 (50)	
Trichlorethylene				Hoschek, 1962 (51) Konietzko, 1975 (52)	

Fluorocarbon 113 — Reinhardt et al., 1973 (53)

Toluene — Bass, 1970 (54)

Phenol — Wilcoskey and Tyroler, 1983 (55)

Methyl chloroform — Stahl et al., 1969 (56)

Cobalt — Barborik and Dusek, 1972 (43); Kennedy et al., 1981 (44); Morin and Daniel, 1967 (45)

* These reports found a positive association with heart disease.

cluded in the study, regardless of whether or not an autopsy was performed. Deaths from suicide, homicide, and traffic accidents were excluded.

Coroner's written records and reports of all county deaths for the four-year study period were carefully reviewed, case by case, and the sudden deaths at work were selected. Demographic, occupational, medical, traumatic, autopsy, and toxicologic information (including certified causes of death) was abstracted from coroner's records. Causes of death were coded by a qualified nosologist according to the 9th Revision of the *International Classification of Diseases* (6). Occupation and industry at the time of death was obtained from the deputy coroner's investigative report of the sudden death, not from the death certificate. Death certificate occupational information has been reported to be inaccurate and often reflects "usual" rather than "current" occupation (7, 8). Industry and occupation data abstracted from the investigative reports were coded by trained, experienced clerks according to the *Alphabetical Index of Industries and Occupations* from the 1980 Census (9). The clerks' training included the completion of the official National Institute for Occupational Safety and Health/National Center for Health Statistics training course on mortality (not Census) coding of industry and occupation. Both the training course and instruction manual were developed by the Bureau of the Census for use by these two agencies (10). The standard of accuracy is 95 per cent or better, although a standard coding test is not given.

Age-race-sex-specific death rates by industry and occupation were computed for white males who died at work in Allegheny County. The numerators were the numbers of deaths at work obtained from the coroner's records. The denominators were the employed Allegheny County population figures obtained in the 1980 census. Since differences in age distribution may affect comparability of mortality rates across sex,

TABLE 2

Epidemiologic studies or case reports* of occupations with increased or decreased coronary heart disease risk

Occupation	Coronary heart disease	Sudden death
Sea pilots	Erikssen et al., 1981 (59) Harrington, 1972 (60)	
Bus drivers	Morris et al., 1953 (61) Netterstrom and Laursen, 1981 (65)	Morris et al., 1953 (62)
Taxi and bus drivers	Holme et al., 1977 (63)	
Transport workers	McMichael and Hartsh, 1982 (64)	
Miners, quarrymen, coal miners	McMichael and Hartsh, 1982 (64) Enterline, 1964 (66) Costello et al., 1975 (negative) (67)	
Clerical workers	Haynes, 1980 (24)	
Jobs with a physical activity gradient:		
Italian railroad	Menotti et al., 1976 (protective) (68)	
California longshoremen		Paffenbarger and Hale, 1975 (protective) (81)
Active British occupations	Morris et al., 1953 (protective) (62) Morris, 1959 (69)	
Active Swedish occupations		Rissanen, 1976 (protective) (82)
Lumberjacks	Karvonen et al., 1961 (protective) (70)	Rissanen, 1976 (protective) (82)
Arsenic smelter	Lee and Fraumeni, 1969 (71) Lee-Feldstein, 1983 (72) Axelson et al., 1978 (73)	
Lead workers	Cooper and Gaffey, 1975 (74) Malcolm and Barnett, 1982 (negative) (75)	
Steel workers	Lloyd et al., 1970 (21) Mazumdar et al., 1975 (76) Redmond et al., 1975 (77)	
Beryllium workers	Wagoner et al., 1980 (78)	
Asbestos workers	Robinson et al., 1979 (79)	
Rubber workers	Wilcoskey and Tyroler, 1983 (55)	
Antimony workers	Brieger et al., 1954 (80)	

* These reports found a positive association with heart disease, unless otherwise indicated above.

race, occupation, and industry groups, these rates were standardized using the direct method (11). We used 1980 Pennsylvania census data as the standard population (12).

RESULTS

Tabulation of the county coroner's records revealed that 242 employees died suddenly at work in Allegheny County during

the study period. The sudden occupational deaths represented about 1 per cent of total deaths in the county during this period (13). Most of the 242 deaths (230 or 95 per cent) were among men; only 12 (5 per cent) were women. Twenty-three of the 242 deaths (10 per cent) were blacks and 219 (90 per cent) were whites. Analyses were restricted to the white male deaths (n = 212) due to the relatively small numbers of women and blacks who died at work in this county during these years. The 212 white male deaths comprised 68 (32 per cent) fatal injuries and 144 (68 per cent) sudden natural deaths (figure 1).
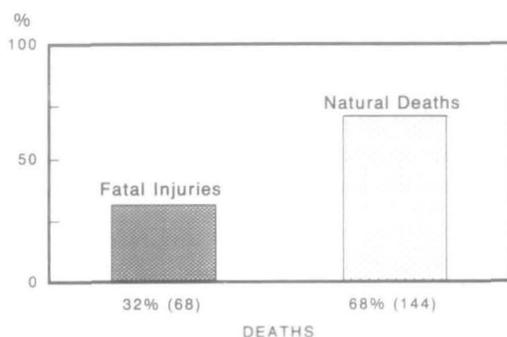
Fatal injuries

Age-specific rates for fatal injuries at work are presented in figure 2. The highest injury rates occurred for ages 16–24 years and ages 65 years and over. The county age-adjusted annual fatal injury rate at work was 5.5 per 100,000 per year for white males (table 3).

Age-adjusted annual rates of fatal injury at work were computed and ranked by industry and occupation (table 3). The construction industry had the highest rate for fatal injuries at work, 24.3 per 100,000 per year. This is over 4.4 times as high as the overall annual county rate. Men who
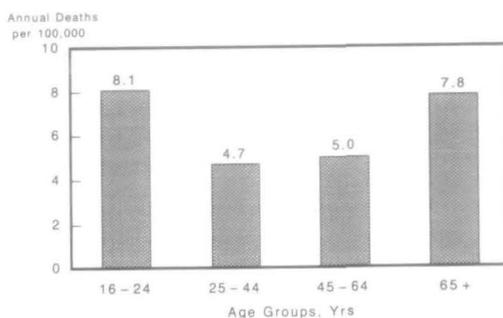

FIGURE 1. Percentages of sudden natural deaths and fatal injuries at work among white males in Allegheny County, Pennsylvania, 1979–1982.

FIGURE 2. Age-specific fatality rates at work among white males in Allegheny County, Pennsylvania, 1979–1982.

TABLE 3

Age-adjusted annual rates of fatal injuries at work per 100,000 white males employed in Allegheny County, Pennsylvania, 1979–1982

Rates	Industries*	Rates	Occupations†
24.3	Construction	20.5	Farming, forestry, fishery
13.2	Agriculture, forestry, fishing, mining	11.4	Precision products and crafts
7.5	Business, repair, personal, entertainment, and recreational services	8.7	Operators, laborers
		2.6	Service
5.9	Communication and public utilities	1.0	Managerial, professional
4.2	Manufacturing	0.7	Technical, sales
3.1	Finance, insurance, real estate		
3.0	Wholesale and retail trade		
2.4	Transportation		
1.0	Professional, public administration		
5.5	All occupations and industries		

* US Bureau of the Census (9) industrial classification codes used: 010–050, agriculture, forestry, fishing and mining; 060, construction; 100–392, manufacturing; 400–472, transportation, communications, and other public utilities; 500–691, wholesale and retail trade; 700–712, finance, insurance, and real estate; 721–802, business, repair, personal, entertainment, and recreation services; 812–932, professional and related services and public administration.

† US Bureau of the Census (9) occupational classification codes used: 003–199, managerial and professional; 203–387, technical, sales, and administration; 403–469, services; 473–499, farming, forestry, fishing; 503–699, precision production, craft, repair; 703–889, operators, fabricators, laborers.

Causes	No. of deaths	%
Motor vehicle (non-road)	13	19
Ladders, scaffolds	8	12
Chemicals	9	13
Electrical apparatus	6	9
Machine	5	7
Pit mines	4	6
Hoist, crane	4	7
Stairs, steps, platforms	3	4
Conveyer belt	2	3
Elevators	1	1
Floors, level surfaces	1	1
Other	12	18
Totals	68	100

worked at farming, forestry, and fisheries occupations were observed to have the second highest fatal injury rate, 20.5 per 100,000. Carpenters and their helpers represented 25 per cent of fatalities in the construction industry and heavy equipment operations represented 21 per cent.

Over 97 per cent (66/68) of the men who died of fatal injuries were autopsied to determine cause of death. The chief cause of fatal injuries was non-road motor vehicles, which were involved in 13/68 (19 per cent) deaths (table 4). Ladders or scaffolds caused 12 per cent (8/68) deaths. Chemicals caused 13 per cent (9/68), and electrical apparatus caused 9 per cent (6/68) of the fatalities.

Multiple fatalities or injuries may result from a single occupational accident. In our data, no other workers were observed to be injured as a result of the sudden natural deaths. However, in 17 (25 per cent) of the 68 fatal occupational injury cases, fellow workers were reported to be hurt or killed as a result of the first fatality. Table 5 shows that burns and explosions caused 41 per cent (7/17) of these deaths. Asphyxia in confined spaces caused 24 per cent (4/17) and crushing injuries caused 24 per cent (4/17). Seven of 17 deaths (41 per cent) occurred in the construction industry. Twelve additional people received nonfatal injuries as a result of the 17 fatalities. In

four cases, the additional person became injured when that person tried to help the fatally injured person.

Raised blood alcohol levels, often implicated in highway and workplace fatalities (14), were not a large factor in Allegheny County occupational fatalities. Blood alcohol level testing was performed for 99 per cent (67/68) of the men who died of fatal occupational injuries. Only 7 per cent (5/67) of workers tested were found to have blood alcohol concentrations equal to or greater than 0.1 mg/100 ml, the level of intoxication (figure 3).

Carboxyhemoglobin levels were determined by the coroner for 99 per cent (67/68) of the fatal injuries. Carbon monoxide poisoning causes 1,500 deaths a year in the United States (15). Exposure to low levels of carbon monoxide causes dizziness, headache, and sleepiness. Trace or elevated carboxyhemoglobin levels were observed in 15 per cent (10/67) of the men who died of fatal occupational injuries (figure 4). Four fatal injury deaths had levels elevated beyond trace amounts. Two of the deaths were due to carbon monoxide poisoning, with levels of carboxyhemoglobin of 73 per cent and 76 per cent. They included a lawyer, who died from fumes emitted by a stove used to heat his office, and a steel mill worker who died from blast furnace emissions. A store clerk, who accidentally shot himself in the head, was found to have an unexplained elevated level of 17 per cent carboxyhemoglobin. A level of 10 per cent carboxyhemoglobin was found in a laborer who had been using paint thinner in a confined space.

None of the fatal injuries was associated with an acute coronary event, such as a heart attack, which might have precipitated the accident. The presence of a myocardial infarction was observed for only one of 60 men whose autopsy report mentioned infarction; however, at autopsy, the infarction was found to be old.

Sudden natural deaths

Figure 5 presents the age-specific rates for sudden natural death at work. Until age

TABLE 5

Occupational incidents involving multiple fatalities in white males in Allegheny County, Pennsylvania, 1979–1982

| Causes	No. of deaths	%	Occupations/industries
Burns and explosions	7	41	
Auto repair shop A			Mechanic (father)/service
Auto repair shop A			Mechanic (son)/service
Auto repair shop A			Mechanic (grandfather)/service
Auto repair shop B			Laborer/service
Steel company D			Iron worker/manufacturing
Steel company E			Welder/manufacturing
Contractor			Laborer/construction
Asphyxia in confined spaces	4	24	
Construction C			Pile driver/construction
Construction C			Foreman/construction
Steel company F			Autoclave operator/manufacturing
Police department			Police officer/professional and administrative
Crushing injuries	4	24	
Construction G			Carpenter/construction
Construction G			Carpenter/construction
Steel company H			Hooker/manufacturing
Steel company H			Hooker/manufacturing
Falls	1	6	
Construction I			Iron worker/construction
Electrocutions	1	6	
Home improvement company			Carpenter/roofer/construction
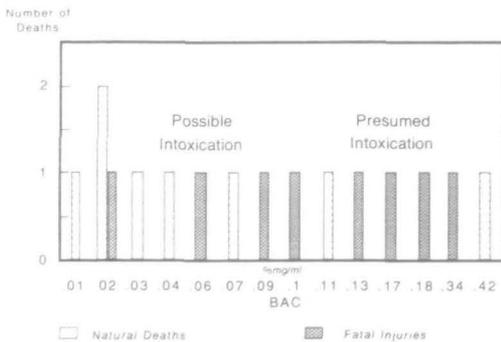
FIGURE 3. Blood alcohol concentrations for sudden natural deaths and fatal injuries at work among white males in Allegheny County, Pennsylvania, 1979–1982.
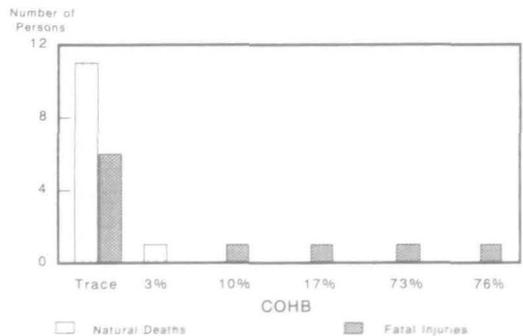
FIGURE 4. Carboxyhemoglobin levels for sudden natural deaths and fatal injuries at work among white males in Allegheny County, Pennsylvania, 1979–1982.

44 years, risk of sudden death was low; however, risk rose quickly for ages 45–64 years, and was highest for ages 65 years and over. The county age-adjusted death rate for sudden natural death at work was 11.2 per 100,000, nearly twice as high as the county age-adjusted annual fatal injury rate of 5.5 per 100,000 (table 6).

Age-adjusted annual rates of sudden natural deaths at work were ranked by industry and occupation (table 6). Men who worked in service occupations were observed to have the highest age-adjusted sudden natural death rate, 27.0 per 100,000.
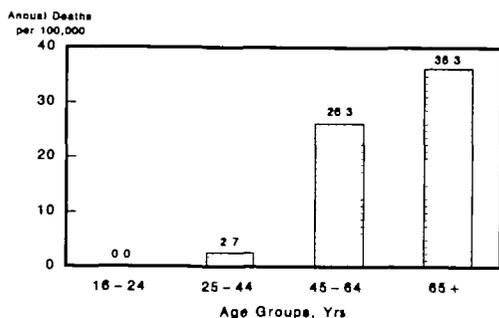

FIGURE 5. Age-specific sudden natural death rates at work among white males in Allegheny County, Pennsylvania, 1979–1982.

Deaths among custodians and maintenance workers accounted for 45 per cent of deaths in service occupations. Deaths among security guards and watchmen accounted for 24 per cent. Two sudden cardiac deaths were observed in firefighters.

Seventy-seven per cent (111/144) of the sudden natural deaths at work received autopsies. Postmortem examination data regarding the circulatory system, mentioned on 86 of 111 reports, were abstracted to obtain the cause of death and are summarized in this paragraph to describe our study population of sudden deaths at work. Review of data showed that fresh occlusion of a coronary artery was observed for 13/86 (15 per cent) of natural deaths, and myocardial infarction was observed in 25/86 (29 per cent). Severe coronary atherosclerosis was observed for 66/84 (79 per cent); and at least moderate stenosis, i.e., 50 per cent of any coronary artery was observed in 69/84 (82 per cent). Left ventricular hypertrophy was observed in 21/85 (25 per cent); and other cardiac disease was observed in 18/86 (21 per cent.)

Blood alcohol concentration was determined for 77 per cent (111/144) of men who

TABLE 6

Age-adjusted annual rates of sudden natural deaths at work per 100,000 white males employed in Allegheny County, Pennsylvania, 1979–1982

Rates	Industries*	Rates	Occupations†
18.6	Business, repair, personal, entertainment, and recreational services	27.0	Service
		14.5	Precision products, crafts
16.2	Communication, public utilities	13.1	Operators, laborers
14.9	Construction	7.8	Farming, forestry, fishery
12.6	Transportation	7.3	Technical sales, support
11.0	Professional, administrative	3.6	Managerial, professional
10.5	Manufacturing		
9.0	Wholesale and retail trade		
7.6	Finance, insurance, real estate		
4.3	Agriculture, forestry, fishing, mining		
11.2	All occupations and industries		

* US Bureau of the Census (9) industrial classification codes used: 010–050, agriculture, forestry, fishing, and mining; 060, construction; 100–392, manufacturing; 400–472, transportation, communications, and other public utilities; 500–691, wholesale and retail trade; 700–712, finance, insurance, and real estate; 721–802, business, repair, personal, entertainment, and recreation services; 812–932, professional and related services and public administration.

† US Bureau of the Census (9) occupational classification codes used: 003–199, managerial and professional; 203–387, technical, sales, and administration; 403–469, services; 473–499, farming, forestry, fishing; 503–699, precision production, craft, repair; 703–889, operators, fabricators, laborers.

died sudden natural deaths. Two per cent (2/111) of workers tested had blood alcohol concentrations that were greater than 0.1 mg/100 ml, the level of intoxication (figure 3). Carboxyhemoglobin levels were determined for 77 per cent (111/144) of sudden natural deaths. Trace or elevated carboxyhemoglobin levels were measured in 11 per cent (12/111) of the men who died sudden natural deaths (figure 4). Trace carboxyhemoglobin levels, which may be found in the general population, described most of the elevated levels. Two firemen who died of heart attacks had elevated carboxyhemoglobin levels: one measured 3 per cent and the other was reported as trace.

Most sudden deaths at work took place within one hour of the onset of symptoms. Death in 42 per cent of sudden natural deaths and 37 per cent of fatal injuries at work occurred within 15 minutes after the incident or onset of symptoms. An additional 30 per cent of persons who died of sudden natural death and 10 per cent of persons with fatal injuries were dead within one hour. The incident or the onset of symptoms was witnessed in 64 per cent of sudden natural deaths and 60 per cent of fatal injuries.

DISCUSSION

Sudden natural deaths

Sudden deaths at work represented about 1 per cent of all deaths in Allegheny County. This represents the deaths of persons among the presumed healthy and fit working population who were not expecting to die. The highest sudden death rate was observed for men employed in the service occupations, including school custodians, janitors, maintenance workers, security guards, and firemen. Other studies have reported increased cardiovascular mortality or risk factor levels, but not sudden death, for men employed in similar service occupations. These include Washington state school custodians (16), prison guards (17), and messengers in the British civil service (18). Our data suggest that sudden death may be a significant portion of the excess cardiovascular risk experienced by men in lower status occupations.

Medical screening at entry into an occupation may only be partially effective in identifying potential heart attack victims. Epidemiologic research has shown that only 50 per cent of all sudden cardiac death victims have a previous clinical history of heart disease (19, 20). Based on coroner's data, only 21 per cent (6/29) of the men who died suddenly at work in service occupations had histories of heart disease or hypertension known to spouses or other survivors.

Service occupations, such as that of security guard, custodian, or night watchman, may be taken as secondary jobs by persons who have left jobs as firemen, policemen, or other mentally or physically demanding or stressful occupations. Studies of the US steel industry (21) suggested that health selection by management explained excess cardiovascular mortality among janitors and plant protection workers. Some service occupations, such as security guards, may involve stressful, sedentary, or solitary work. This may present special hazards for persons who have left physically demanding or stressful jobs. A study of Finnish foundry workers (22) found that men who went from heavy to light occupations had the highest risk of cardiovascular mortality. Occupational stress (23, 24) has been related previously to coronary heart disease incidence. Vigorous physical activity was reported in another study (25) in association with a two- to threefold increased risk of sudden cardiac death.

Solitary work may present hazards for persons who may work alone or during evening hours. Sudden deaths at work, particularly fatal heart attacks, might be prevented by better management of stressful, sedentary, or solitary work. For example, a portable, automatic signaling system could be devised for use by the solitary worker who may need rapid emergency first aid for a heart attack. An alert system would protect solitary workers against life-threatening situations. Surveillance of solitary

workers may reduce the risk of sudden deaths at work.

Three sudden deaths at work in our study involved firefighters. One was electrocuted when the boom of the cherry picker he was operating while fighting a fire hit a high voltage wire. The other two both died of heart attacks in the fire station after fires. All three had trace amounts of carboxyhemoglobin in their blood at the time of death. The role of exposure to combustion products and exertion in carboxyhemoglobin accumulation in firefighters has been documented in previous studies (26, 27). Cardiovascular and respiratory system diseases are recognized occupational diseases of firefighters (28). However, a mortality study of Boston firefighters concluded that their mortality rates were not strongly associated with firefighting as an occupation; although, the authors felt their survival experience may have been influenced by entry selection, ethnic derivation, or sociocultural attributes (29).

Several occupational exposures have been shown to cause sudden death, such as nitroglycerin, fluorocarbons, carbon disulfide, and other solvents listed in table 1. The extent of occupational exposure to these agents in our study population is unknown since no cardiotoxic agents were mentioned in the county coroner's records or on the death certificates as possible factors in the sudden cardiovascular work deaths. Future investigations of sudden deaths at work should seek information on any potential exposures to cardiotoxic agents used industrially.

Our study found, as did a previous study (14), that the coroner's records identified more sudden deaths at work than did death certificates. The county coroner's records may represent an underutilized surveillance system for sudden deaths which occur at work. Sudden natural deaths at work can not usually be recognized or identified from death certificates. There is no public health office which receives reports of heart attacks which occur at work. The Occupational Safety and Health Administration routinely receives reports of fatal work injuries. It does not routinely receive reports of all heart attacks at work. Heart attacks at work, which occurred twice as often as fatal injuries at work in Allegheny County, are only investigated by the Occupational Safety and Health Administration if they occurred under highly unusual circumstances or were clearly work-related.

Fatal injuries

Work accidents involving nontransport vehicles were the highest single cause of fatalities at work. Table 4 shows 19 per cent (13/68) of work fatalities involved nontransport motor vehicles. Falls from open vehicles and backing up and running over operators not in the vehicle were the most common circumstances of injury. Seat belt use was not mentioned in the records. In two of the injuries, broken back up lights were cited. Proper maintenance and operation of nontransport motor vehicles could reduce the high rate of fatality associated with their operation. Baker et al. (14) reported road transport vehicles to be the single largest cause of fatalities on the job in Maryland in 1978, with nontransport vehicles being the second highest cause of worker deaths.

In our study, the construction industry involved the largest number of workers killed and had the highest age-adjusted fatality rate of all industries; however, it represented only 5 per cent of the employed population. This industry was ranked third nationally in 1984 for fatal injuries at work by the National Safety Council (2). The construction industry was also ranked third by a death certificate study of fatal injuries at work in Texas (30). Fifty-four per cent (7/13) of the fatalities that involved multiple injuries occurred in the construction industry in our study (table 5). Prevention strategies aimed within the construction industry may be particularly appropriate and effective in reducing the overall numbers of fatal injuries.

Better worker safety training, education, and equipment may be needed to prevent

potentially catastrophic incidents of multiple fatality and injury at work. Table 5 shows that at least 25 per cent (17/68) of fatalities involved the injury or death of fellow workers or innocent bystanders who were not included among the 68 fatal work injuries we studied. For example, multiple injuries occurred in our study when a co-worker tried to rescue the victim. In three of the 17 incidents, persons who attempted to help burn victims were severely burned themselves. Two separate incidents were reported of rescue workers, including one policeman, who became unconscious and were asphyxiated after descending without respirators into a pit or a minehole.

Death rates for occupational fatalities are gathered and calculated in a variety of ways. Although increased or decreased rates have been reported for different geographic areas, the rates themselves may not be truly comparable. Their incomparability may obscure any real differences between the rates, or make any apparent differences difficult to interpret. For example, our annual age-adjusted fatal injury rate in Allegheny County 1979–1982 was 5.5 per 100,000 actively employed white males. The National Safety Council (2) estimated the age-adjusted US death rate for fatal injuries at work to be 13 per 100,000 workers in 1980. A study of fatal occupational injuries in Maryland (14) reported an overall state rate of only seven fatalities per 100,000 civilian workers for 1978. A study in Texas (30), meanwhile, reported an overall state rate of 18 fatalities per 100,000 experienced civilian workers.

Each of these reports cited different data sources and used varied definitions for categories of fatal injuries included. The National Safety Council obtained data directly from several state industrial commissions, as well as from state and local vital statistics offices for use in their publication "Accident Facts." Our data were obtained from the county medical examiner, as were the Maryland study data. The Texas data were based only on death certificates. The Maryland study included auto deaths as well as

homicides; however, our study did not include either. Thus, fatal injury rates at work are not comparable between these studies. However, in Maryland, state medical examiner's records were observed to provide the most comprehensive source for the identification of fatal injuries at work (14). Similarly, our study found that only 57 per cent of fatal occupational injuries could be identified from death certificates, compared with the county coroner's records, which identified 100 per cent.

Sudden deaths at work may represent a unique opportunity for surveillance and prevention. Future surveillance on sudden deaths at work might include comparison of county rates of sudden death at work by industry. New computerized tracking systems, which are beginning to be used by some coroners' offices make this surveillance feasible. A computerized network which links data between county health offices and coroners' offices might be an inexpensive and efficient method to increase control of the preventable sudden deaths that take place at work.

Conclusion

The descriptive epidemiology of sudden death at work was studied in an urban, industrial county with the use of the county coroner's records. Annual age-adjusted death rates revealed that sudden natural deaths (primarily heart attacks) occurred twice as often at work as fatal injuries between 1979 and 1982. Service occupations were observed to have the highest annual age-adjusted rate of sudden natural death at work, 27.0 per 100,000 employed persons. The construction industry was found to have the highest annual age-adjusted rate of fatal injury at work, 24.3 per 100,000 employed persons. Accidents involving multiple fatalities and injuries occurred in 25 per cent of all fatal accidents at work. Fifty-four per cent of accidents that involved multiple fatalities occurred in the construction industry.

Improvements in the prevention and surveillance of sudden deaths that occur at

work were suggested. The use of coroners' records systems as the basis of a surveillance network of sudden deaths at work, including both injuries and heart attacks, was suggested.

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