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Mortality of auto mechanics

A ten-year follow-up

by Eva S Hansen, MD, PhD[1]

HANSEN ES. Mortality of auto mechanics: a ten-year follow-up. *Scand J Work Environ Health* 1989;15: 43—46. This study was set up to investigate whether work in car repair workshops is associated with an increased risk of ischemic heart disease and specific malignant neoplasms. For this purpose, a cohort of auto mechanics has been followed through 10 years with regard to cause-specific mortality. Comparisons were made with another cohort of skilled male workers who were not exposed to asbestos or petrochemical substances. The auto mechanics' mortality was increased for ischemic heart disease [standardized mortality ratio (SMR) 121, 95 % confidence interval (95 % CI) 102—145], other cardiovascular diseases (SMR 112, 95 % CI 82—150), cancer (SMR 115, 95 % CI 97—136), other diseases (SMR 119, 95 % CI 94—149), and external causes (SMR 131, 95 % CI 113—153). For specific cancer sites, increases were seen for pancreatic cancer, urinary cancer outside the bladder, and pleural mesothelioma.

Key terms: asbestos, car repair, carbon monoxide, ischemic heart disease, mesothelioma, occupation, pancreatic cancer, petrochemical substances, polycyclic aromatic hydrocarbons, urinary cancer.

The work environment of auto mechanics involves potential exposure to asbestos, mineral oils, solvents, paint pigments, anticorrosive substances, and automobile exhaust. The literature on work-related health hazards is sparse regarding auto mechanics. Increased risks of both bladder cancer and lung cancer have been reported (1—3). In addition a few cases of malignant mesothelioma have been reported for auto mechanics, especially among persons employed in brake service centers (3—5). With regard to other occupational groups whose exposure may resemble that of auto mechanics, increased cardiovascular mortality has been reported for motor vehicle examiners (6), whereas increased mortality from digestive cancer has been found among automobile manufacturing workers and other metal workers (7, 8).

The actual study was set up to investigate further the potential health hazards associated with the complex exposure situation typical for the work environment in Danish car repair workshops. Malignant neoplasms of the respiratory system, the urinary system, and the upper digestive organs were anticipated to be of particular interest, together with cardiovascular diseases.

Subjects and methods

The research design was that of a historical cohort study in which the exposed part of the cohort was compared with the unexposed part in terms of cause-specific mortality through a ten-year period of follow-up. Auto mechanics constituted the exposed part of the study cohort. The comparison population, ie, the unexposed part of the study cohort, was made up of other specific groups of skilled workers.

The members of the study cohort were identified from the files of a nationwide census carried out in Denmark on 9 November 1970. Self-reported occupation, trade, industry, and employment on the day of the census was recorded for all the Danish inhabitants older than 14 years of age. These data were used to select the persons included in the study.

The study comprised only skilled workers and apprentices, only men between 15 and 74 years of age, and only persons who were occupationally active (ie, employed) on the day of the census. Everybody with the title "auto mechanic" or "mechanic, employed at a car-repair workshop" was included as an exposed person. As unexposed persons all men with one of the following job titles were included (proportion of total comparison group in parentheses): carpenter (45 %), electrician (32 %), instrument maker (13 %), dairyman (5 %), upholsterer (3 %), or glazier (2 %). Table 1 shows the number of exposed and unexposed persons in ten-year age groups.

The Danish National Bureau of Statistics has linked the records of the 1970 census with the current central register of persons and the national register of deaths [publications numbers 37 (1979) and 41 (1985) from the Danish National Bureau of Statistics, both in Danish]. This procedure has enabled the total census population to be followed for 10 years. The actual study cohort formed part of the census population and was traced by the use of the existing register linkage. The study persons were traced until 8 November 1980 or till death or emigration prior to this date. The follow-up data are shown in table 2. The auto

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Table 1. Number of exposed persons (auto mechanics) and the comparison population of unexposed skilled workers by age.

Age (years) on 9 November 1970	Auto mechanics		Comparison population	
	N	%	N	%
15—24	13 882	64	25 159	49
25—34	4 661	21	12 633	24
35—44	1 545	7	6 118	12
45—54	949	4	3 976	8
55—64	662	3	3 148	6
65—74	101	0.5	713	1
15—74	21 800	100	51 747	100

Table 2. Follow-up data for the auto mechanics and the comparison population of skilled workers from 9 November 1970 through 8 November 1980.

	Auto mechanics	Comparison population
Number of deaths	586	1 903
Number of emigrants*	581	1 665
Number of persons alive and living in Denmark at the end of the follow-up	20 633	48 179

* Includes persons lost to follow-up. The register linkage did not allow for separating emigrants and persons lost to follow-up.

Table 3. Mortality of Danish auto mechanics in 1970—1980. (SMR = standardized mortality ratio, 95 % CI = 95 % confidence interval)

Cause of death*	Observed number	Expected number	SMR	95 % CI
Cancer (140—209)	148	128.8	115	97—136
Ischemic heart disease (410—414)	132	108.7	121	102—145
Other cardiovascular diseases (390—404, 420—458)	46	41.0	112	82—150
Other diseases	76	64.0	119	94—149
External causes (E000—E999)	175	133.2	131	113—153
Unknown	6	5.9	101	37—220
Total	583	481.5	121	112—131

* The code of the International Classification of Diseases (eighth revision) in parentheses.

mechanics and the comparison population of unexposed skilled workers contributed 192 300 and 481 642 person-years at risk, respectively, to the study.

Deceased persons, emigrants, and persons lost to follow-up contributed person-years at risk up until the day of death, the day of emigration, or the last day of notification in the central register of persons.

For deceased persons, information on the underlying cause of death was derived from the death certificate. The numbers of deaths expected for the auto mechanics were calculated from the death rates of the comparison population and the number of person-years at risk accumulated by the auto mechanics.

For the statistical evaluation, the observed numbers of deaths beyond 100 were assumed to follow a normal distribution (Yates' correction was employed), whereas, for smaller numbers, a Poisson distribution was assumed. The death rates of the comparison population were assumed not to be influenced by random variation. Confidence intervals (CI) for the standardized mortality ratio (SMR) were calculated by the method proposed by Miettinen (9) whenever the observed number of deaths exceeded 100. For smaller numbers of deaths, exact Poisson limits were calculated (10).

Results

The number of deaths observed among the auto mechanics exceeded the expected number by 21 %. The increased mortality was not confined to any single group of causes of death (table 3).

As regards specific cancer sites, increases were seen for pancreatic cancer, pleural mesothelioma, and urinary cancer outside the bladder (table 4).

Discussion

The auto mechanics' mortality has been evaluated against that of skilled men in other trades, free from occupational exposure to petrochemical products, asbestos, and paint pigments. However, some of the persons included in the comparison group may have been occupationally exposed to other agents associated with increased mortality from, eg, cancer. In this case, a potentially increased risk for auto mechanics may have been masked.

According to the concept introduced by Hernberg (11), the actual cohort study was rather insensitive. Only occupationally active and therefore healthy workers were enrolled in the cohort, and the period of follow-up was rather short. "Exposure" was defined by a person's occupation and industry and determined at one point in time, namely, the day of the census. In Denmark skilled workers tend to stay in one industry throughout their worklife. Thus, for the actual study, the census data may represent a reasonably good proxy for lifetime occupation and industry. However, the crudeness of the employed definitions dilutes the exposure contrast under study, and some effects of the auto mechanics' work environment may have gone undetected.

Selection of the occupational groups included in the comparison population enabled the group to resemble auto mechanics with respect to work-related demands on physical strength and fitness, social class membership, and geographic distribution. In spite of this group control for social class, life-style habits may have differed between the compared populations. The

Table 4. Danish auto mechanics' mortality from specific malignant neoplasms in 1970—1980. (SMR = standardized mortality ratio, 95 % CI = confidence interval)

Cancer site*	Observed number	Expected number	SMR	95 % CI
Esophagus (150)	4	3.4	116	32—298
Stomach (151)	7	6.8	104	42—214
Pancreas (157)	17	7.8	219	128—351
Other digestive organs (152—156, 158—159)	16	17.0	94	54—153
Bronchus and lung (162.1)	41	40.7	101	72—137
Pleura (163.0)	1	0.0	·	·
Other respiratory organs (160—162.0, 163.1—163.9)	1	0.3	400	10—2229
Bladder (188)	4	4.1	98	27—250
Other urinary organs (189)	8	4.6	174	75—343
Other sites (140—149, 170—187, 190—209)	49	44.2	111	82—147
Total (140—209)	148	128.8	115	97—136

* The code of the International Classification of Diseases (eighth revision) in parentheses.

auto mechanics' high mortality from external causes points to differences regarding risk-taking behavior. On the other hand, the fact that no differences were found for lung cancer indicates that the results have not been positively biased by smoking habit differences. Actually, smoking is prohibited in many places in car repair workshops, and the auto mechanics may in fact have smoked less than the persons in the comparison group.

The number of deaths ascribed to ischemic heart disease exceeded the expected number by 21 %, an effect which is of the same order of magnitude as that of smoking 1—14 g of tobacco per day (12). The observed excess of deaths from ischemic heart disease is remarkable, particularly in view of the rather short period of follow-up. Ischemic heart disease usually has a protracted course rich in symptoms and increasing disablement. Persons with symptoms of cardiac ischemia are rare among active blue-collar workers, and with short-term follow-up one usually finds a very low mortality due to ischemic heart disease in such groups.

The difference between the auto mechanics and the comparison group with respect to ischemic heart disease may either be due to specific occupational exposures or to confounding by life-style factors. With regard to the latter, smoking can be ruled out because of the aforementioned lack of difference in lung cancer mortality between the groups. Hypothetically, the compared populations may have differed in dietary habits or leisure-time activities. However, such differences would have had to be unusually extreme to bring about an effect equaling the actual order of magnitude. With respect to work-related hazards, the auto mechanics may be exposed to suspected atherogens like carbon monoxide and polycyclic aromatic hydrocarbons through the inhalation of automobile exhaust and during the handling of petrochemicals such as, eg, anticorrosive substances, solvents, and mineral oils. Previously, a slight increase in cardiovascular mortality (SMR = 105) has been reported for motor vehicle examiners, whose exposure may resemble that of auto mechanics (6).

Pancreatic cancer occurred in excess among the auto mechanics. However, for such a rare disease, the comparison population may have been too small to justify the assumption that random variation has not influenced the death rates. Therefore, reservations should be made as to the statistical evaluation of the data on mortality from pancreatic cancer. Little is known about the etiology of pancreatic cancer. Tobacco smoking seems to be of importance, alcohol not (12—15). Studies on occupational mortality have indicated that this cancer site is associated with work in the metal industry (7, 8), the chemical industry (16, 17), especially in the production of beta-naphthylamine and benzidine (18), and with exposure to petroleum products (19, 20). Animal assays have pointed out nitrosamino compounds, acetaminofluorene, p-dimethylaminoazobenzene, and methylnitrosurea as carcinogens with affinity to the exocrine pancreas (21—24). The chemical substances in the auto mechanics' work environment may include nitrosamino compounds formed from, eg, sodium nitrite and triethanolamine, both of which are in current use as mineral oil additives.

Asbestos exposure is known to occur during the replacement of brake linings, and the single case of pleural mesothelioma is an indication that this exposure has not been negligible. On the basis of this background, it is remarkable that the auto mechanics' lung cancer mortality was not increased. The possibility that smoking has been less prevalent among the auto mechanics than in the comparison group has already been mentioned. If present, such a difference would result in negative confounding as regards lung cancer and other tobacco-related diseases.

For specific cancer sites other than lung cancer and pancreatic cancer, the observed numbers of death were too small to state or rule out a potentially increased risk.

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