Review of the literature regarding ischemic heart disease (IHD) among female cleaners in Medline and NIOSHTIC for 1990-2001 yielded one specifically relevant study, three surveys of several occupations, and one case-referent study. All showed minor increases of standardized mortality ratios or relative risks regarding diseases of the circulatory system, IHD, or myocardial infarction among female cleaners. Many determinants might explain the female cleaners' increased risk for IHD, e.g., imbalances regarding job strain and effort–reward, anxiety and depression, periodontal disease, smoking habits and air pollutants. These factors need further exploration.

**Key words:** air pollutants; anxiety; depression; effort–reward; job strain; periodontal disease; smoking habits.

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Prior to the 1960s, the trend in mortality from coronary heart disease was generally upwards in the industrialized countries. The trend was more pronounced in men than in women, but this disease became a leading cause of death of middle-aged and older people of both sexes. The death rate declined between 1950 and 1985 in most industrialized countries except in Eastern Europe. A low occupational social class is associated with an increased occurrence of coronary heart disease among females as well as males. These authors also observed a higher concentration of plasma fibrinogen among female manual workers compared with non-manual workers, and an increased plasma level of fibrinogen is an established risk factor for ischemic heart disease (IHD). Among female manual workers the incidence of first and recurrent myocardial infarctions increased between 1971 and 1986 in Stockholm County. Many of these female manual workers are cleaners. The purpose of this paper is to report the results of a survey of the literature regarding the occurrence of ischemic heart disease (IHD) in female cleaners.

**METHOD**

A literature search was performed including the terms “cleaners” and “ischemic heart disease” in Medline and NIOSHTIC for the period 1990–2001.

**RESULT**

Only one study was retrieved from the literature search for the combination of female cleaners and IHD. Occupational information was obtained from the 1971 census records of women in the Longitudinal Study carried out by the Office of Population Censuses and Surveys comprising a sample of 1% of the population of England and Wales. The analysis was based on 77,081 women aged 15–59 years. Carnwomen, office cleaners, and window cleaners had an increased SMR regarding IHD of 1.35 based on ten deaths, which is not a statistically significant increase. The following studies were not retrieved in the literature search. An occupational mortality study in the Nordic countries was based on the censuses and their linkage to mortality statistics. The survey population consisted of individuals aged 20–64 years around the first of January 1971. The follow-up period was ten years, starting in 1971 and ending in 1980. The reference population consisted of all economically active persons. The number of deaths due to diseases of the circulatory system and “sudden death” (ICD 390-458, 782.4, and 795) among female cleaners was 4,046, with a SMR of 1.19. All of the four countries (Denmark, Finland, Norway, and Sweden) had SMRs above 1.0, and the highest SMR was found in Finland 1.48. Denmark had a SMR of 1.16, Norway 1.11, and Sweden 1.06. A further follow-up was performed in Finland, where the population was followed until 1991. Myocardial infarction was more common among female cleaners and cleaning supervisors compared with the reference population (SMR 1.07 based on 1,640 deaths). It is interesting that younger persons (25–44 years in 1970) had a higher risk (SMR 1.45, 95% CI 1.20–1.75) compared with older persons (45–64 years old in 1970), who had an SMR of 1.05 (95% CI 1.01–1.11). This result might be explained by a higher proportion.
of individuals who were retired and consequently were not exposed during the whole follow-up period.

A further follow-up of census information linked to mortality data has also been conducted in Sweden. Three different cohorts of cleaners were traced until December 31, 1995, the first cohort being all cleaners at the 1970 census, the second cohort comprising all cleaners at the 1980 census who were also recorded as cleaners in the 1970 census, and the third cohort comprising all cleaners at the 1990 census. These cohorts are not independent as one individual might belong to one, two, or all three. Deaths due to IHD were more common in all cohorts of cleaners\(^8\) (Table 1).

A Swedish case–control study included 9,755 women with myocardial infarctions. For each case two controls were selected from the study base through random sampling, stratified by age, county, and socioeconomic group. An increased risk was found among female cleaners (RR 1.2, 95% CI 1.0–1.5), after adjustment for age, county, and calendar year. The risk decreased after adjustment for socioeconomic group (RR 1.1, 95% CI 0.9–1.4).\(^9\)

### DISCUSSION

Computerized searches of the literature do not always find relevant studies of specific occupations. The reason seems to be that not all occupations are key words in census and case-referent studies.

The empirical evidence of the job-strain model in explaining cardiovascular disease is quite convincing. Particularly the control dimension seems strongly linked to heart disease, and a majority of studies found an association between low control and coronary heart disease.\(^10\) The Swedish Work Environment Survey 1989–1997 was used to construct a new matrix measuring control, demand, and support. As expected in an occupation requiring little formal education, control was estimated to be lower among cleaning women (5.0 points) compared with all employed women (5.8 points), and psychological demands were also lower among female cleaners (8.0 points) compared with all employed women (6.2 points).\(^11\) Hence, low control among female cleaners may have contributed to the increased risk of heart disease in the occupation.

Anxiety and depression are strongly related to coronary heart disease.\(^12\) Little is known about the occupational distribution of such problems, but it is known that clinical depression as well as depressive symptoms are more common in lower than in higher social strata.\(^13,14\) While anxiety disorders such as panic syndromes and phobias seem to be more common in lower social strata, symptoms of anxiety may lack relation to social class or even be more common in higher strata.\(^15,16\)

The job-strain model has been rather thoroughly investigated in relation to symptoms of anxiety and depression. In the Whitehall study it was found that low social support, low decision authority, and high demands were longitudinally related to such symptoms as those measured by the General Health Questionnaire.\(^17,18\) The same findings were made in a French study with a longitudinal design.\(^19\) As stated above, cleaners typically have low demands and low control, and it is hard to predict from this model whether symptoms of anxiety and depression should be more or less common among cleaners than in other occupational groups.

In a 1994 survey of a random sample of the population in Stockholm between 20 and 64 years of age, cleaners were one of the female occupational groups, together with teachers and restaurant workers, that most often reported symptoms of anxiety and depression.\(^20\)

It seems likely that symptoms of anxiety and depression should be more common among cleaners than among the average of other occupational groups. However, it is difficult to determine to what extent this may have influenced the increased risk for coronary heart disease among cleaning women.

Among Swedish female long-term employed cleaners an increased occurrence of hospitalization and mortality was observed regarding alcohol-related diagnoses.\(^21\) Small doses of alcohol are associated with a decrease in coronary heart disease mortality. High doses of alcohol, more than 5 drinks per day, are not associated with decreased mortality due to coronary disease and might be associated with an increased mortality.\(^22\) Information is insufficient to estimate the impact of alcohol consumption among female cleaners regarding mortality due to IHD.

Smoking is strongly associated with IHD and male smokers have a risk ratio of 2 compared with non-smokers.\(^23\) Women have been assumed to have the same RR as men regarding smoking.\(^24\) If female cleaners smoke more than women in general, this could explain the observed higher risk. If the proportion of smoking women in general is 40% and the proportion of smoking female cleaners is assumed to be as high as 60%, the following calculations could be made in order to estimate the relative risk, as proposed by Axelson and

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**TABLE 1. Mortality Due to Ischemic Heart Disease (ICD 8 or 9, 410–414) among Female Cleaners in Sweden Followed until December 31, 1995\(^8\)**

<table>
<thead>
<tr>
<th>Census</th>
<th>No. of Persons</th>
<th>No. of Deaths</th>
<th>SMR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>83,285</td>
<td>4,850</td>
<td>1.25</td>
<td>1.21–1.28</td>
</tr>
<tr>
<td>The same occupation 1970 and 1980</td>
<td>24,396</td>
<td>487</td>
<td>1.34</td>
<td>1.22–1.46</td>
</tr>
<tr>
<td>1990</td>
<td>90,271</td>
<td>104</td>
<td>1.25</td>
<td>1.02–1.51</td>
</tr>
</tbody>
</table>

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Steenland.\textsuperscript{25} \(I_{wg}\) is the incidence for women in the general population regarding IHD. \(I_o\) is the incidence for non-smoking women and \(I_c\) is the incidence for female cleaners. \(RR_c\) is the risk ratio for IHD comparing smokers and non-smokers.

\[
I_{wg} = I_o \times 0.6 + RR_c \times I_o \times 0.4 \\
I_c = I_o \times 0.4 + RR_c \times I_o \times 0.6
\]

Based on these hypothetical smoking habits, the estimated calculated relative risk (\(I_c/I_{wg}\)) was 1.14 when female cleaners were compared with the general population. Thus, one part of the observed risks might be explained by smoking habits, but many of the observed risks are unlikely to be explained by differences regarding smoking habits.

House dust induces an interleukin response from lung epithelial cells. The production of interleukin-6 (IL-6) and interleukin-8 was increased in a dose-dependent manner, and the interleukin production was severalfold higher compared with swine dust which was used as a positive control.\textsuperscript{26} Inhalation of swine dust caused an increase of serum IL-6 and plasma fibrinogen in volunteers exposed for four hours.\textsuperscript{27} IL-6 is known to stimulate hepatocytes to secrete fibrinogen,\textsuperscript{28} and an increased plasma level of fibrinogen is an established risk factor for IHD.\textsuperscript{3} A general hypothesis has linked interleukin to the occurrence of IHD in the following way. Inhalation of air pollutants retained in the lungs will hypothetically create a low-grade inflammation associated with an increase in plasma fibrinogen and possibly other factors of coagulation. A high concentration of fibrinogen will increase the likelihood for blood cloting and thereby the risk for myocardial infarction and IHD.\textsuperscript{29,30}

During 1997–1999 a Swedish Work Environment Survey was performed based on a sample of approximately 10,000 members of the employed population.\textsuperscript{31} According to this survey, 37% of female cleaners reported exposure during at least one fourth of their working hours to air pollutants, compared with 18% of all participating women. In a Spanish study the majority of cleaners (36 of 67) reported respiratory symptoms.\textsuperscript{32} Nose and throat symptoms were common among 775 Danish female cleaners, 44%, and most of them reported alleviation of symptoms during holidays and on weekends. Chronic bronchitis was more common among the cleaners who continuously used sprayers (OR 3.2, 95% CI 1.0–10.4).\textsuperscript{33} Chronic cough was studied in the original Framingham Heart Study. Chronic nonproductive cough (OR 1.8, 95% CI 1.1–2.8) and productive cough (OR 1.6, 95% CI 1.1–2.4) were both associated with the occurrence of myocardial infarction.\textsuperscript{34} In these calculations adjustments were made for age, gender, smoking, FVC, diabetes mellitus, systolic blood pressure, left ventricular hypertrophy on ECG, angina pectoris, and total cholesterol level. Persons with chronic nonproductive cough had significantly higher plasma levels of fibrinogen compared with persons without cough.

Shift work has been associated with an approximately 40% increased risk of cardiovascular disease.\textsuperscript{35} In Sweden fewer female cleaners had evening or night work or worked alternating or rotating shifts (13%) compared with all women (25%).\textsuperscript{31} In 1988–89 the percentage of non-skilled workers without their own teeth (12%) was higher compared with the general population in Sweden.\textsuperscript{36} The number of remaining teeth was negatively related to periodontal disease in Canada,\textsuperscript{37} and periodontal disease is strongly related to IHD.\textsuperscript{38}

Psoriasis has been associated with cardiovascular disease.\textsuperscript{39} There has been no reported study linking cleaners to psoriasis, but cleaners more often have hand eczema compared with the total population.\textsuperscript{40} However, there is to our knowledge no study linking hand eczema to IHD.

In conclusion, several studies of female cleaners have observed an increased risk regarding diseases of the circulatory system, IHD, and myocardial infarction. Many determinants might explain this observation, e.g., imbalances regarding job strain and effort–reward, anxiety and depression, periodontal disease, smoking habits, and air pollutants. All these determinants need to be further explored. Most of them could be investigated by comparing cleaners with comparable referents. However, the effects of air pollution might be possible to study before and after exposure by measuring biological indicators of exposure such as IL-6 and fibrinogen. Such studies have already been performed regarding exposure to swine dust\textsuperscript{27} and mixed stone dust.\textsuperscript{31}

References


