Increased risk of asthma among Finnish construction workers

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Aim To determine the risk of asthma among 7891 Finnish construction workers in the Pirkanmaa Region of southern Finland.

Method Retrospective cohort study of hospital records of the Tampere University Hospital. A population of Pirkanmaa paper mill workers (n = 2686) and the Pirkanmaa working age population (n = 252 500) served as reference populations.

Results There were 147 new cases of asthma among the construction workers in 1991–1995. The annual rate was 37 per 10 000 workers and the odds ratio was 2.1 [95% confidence interval (CI) = 1.2–3.6] for the women and 1.8 (95% CI = 1.5–2.2) for the men when compared with the general working age population. In general, the risk of asthma among the paper mill workers did not differ from the risk of asthma among the general working age population. The construction workers had an increased risk for asthma, although the number of reported cases of occupational asthma was lower for the construction workers than for the paper mill workers or for the working population.

Conclusion Construction work, especially dusty tasks, was associated with an elevated risk of asthma. Thus the effect of exposure to irritant agents may have a role in the development of asthma among construction workers. For the most part, these cases of asthma do not meet the criteria for occupational asthma because the specified causal agent cannot be defined. The aetiologic agents and mechanisms of asthma in construction work should be clarified for preventive measures.

Key words Asthma; construction worker; occupational asthma; occupational disease; work-related asthma.

Introduction Occupational exposure to sensitizing agents such as isocyanates, epoxides, acrylates, cobalt, isothiazolinone, aziridine, wood dust, formaldehyde, chromium, nickel and rubber chemicals is possible in construction work [1]. Non-specific irritating agents in the air of the workplace may also play a part in the development of asthma [2–5].

The risk of asthma among construction workers has generally not been considered high, but the healthy worker effect of this mobile workforce may have reduced the reported rate of asthma. In the USA, the rate ratio of self-reported asthma among construction workers was found to be 0.82 [6]. Furthermore, the construction industry may have sub-populations of workers whose elevated risk of asthma remains unrecognized in research on the entire set of diverse trades [7]. Studies using self-reporting, physician-reporting or insurance-based surveillance have indicated an increased risk of asthma in some specific occupational groups of the construction industry [8–10]. In a study from Singapore, the risk of asthma among construction or renovation workers was increased [odds ratio (OR) = 2.24, 95% confidence interval (CI) = 1.30–3.85] [2]. However, the occupation
had been determined by the phrase ‘ever employed in construction industry’, which does not make the observed associations highly specific.

Only between one and six cases of occupational asthma (0.1–0.5/10 000 workers) were reported to the Finnish Register of Occupational Diseases for construction workers annually between 1991 and 1995, totalling 14 cases [11]. The problem may be that, generally, only about one-third of the occupational diseases of construction workers are reported [12, 13]. On the other hand, workers with severe respiratory problems in dusty tasks probably choose another career.

The aim of this study was to assess the incidence of asthma and calculate the OR for this disease among construction workers in Finland.

Methods
We gathered all the new cases of asthma diagnosed by chest physicians of the Tampere University Hospital in southern Finland between 1991 and 1995 among people of 20–64 years of age. In the Pirkanmaa region, this is the only hospital with a pulmonary clinic, and >95% of all asthma cases in the region are diagnosed there. Approximately 252 500 working-aged people (20–64 years) live in the catchment area of the pulmonary clinic. The patients with a diagnosis of extrinsic asthma, intrinsic asthma, other specified asthma or non-specified asthma were included in this study. Non-specified asthma comprised most of the suspected asthma cases under examination. About half of them did not meet the criteria of asthma in a more detailed study, although the patients had asthma-like symptoms. During 1991–1995, the Tampere University Hospital used the American Thoracic Society criteria [14] in its diagnostic procedure.

In this study, we defined a construction worker as a person having worked in the construction industry for >3 months yearly during at least 3 years between 1980 and 1995. If a person had stopped working in the construction industry in 1988 or earlier, he was excluded from the construction worker population. We linked the register of the Employment Pension Fund of construction workers and the hospital records of the asthma patients. The Employment Pension Fund includes all construction workers except municipal employees and independent entrepreneurs, who constitute <15% of all construction workers.

Because the occurrence of asthma differs for men and women, and it also differs for various ages, we stratified the data according to gender and age. The yearly number of construction workers was obtained from the records of the pension fund. The numbers separated by gender, age and working months are available for the whole country, but not separately for the Pirkanmaa region. We estimated the number of workers in Pirkanmaa in 1991 using the numbers of person-years for the whole of Finland and Pirkanmaa, both of which were available. The number of female construction workers (<6% in the entire Finnish construction worker population) was so low that age-stratified data could not be obtained accurately enough for them. Therefore, the age-specific ORs have not been shown for women.

Paper workers from one paper mill company in the Pirkanmaa region were selected as controls, representing an industrial population. The number of workers had remained constant during the years of the study and, because data for earlier years were not available, we used data for 1994 to determine the size of the paper mill worker cohort.

The Statistical Yearbook of Finland and Central Statistical Office of Finland provided information on the number of people in the general working age population in 1991 in Pirkanmaa. The age-specific gender distribution of the Pirkanmaa region was not available, but it was available for the entire country. Thus, we used the age-specific gender distribution of Finland and fitted it into the age-specific distribution of the inhabitants of the Pirkanmaa region. The construction and paper mill workers were excluded from these numbers.

We compared the OR of asthma between the construction workers and both the paper mill workers and the general working age population of the Pirkanmaa region. The ORs and their CIs were calculated as described by Gardner and Altman [15] with Confidence Interval Analysis (version 1.1) software.

The incidence of all asthma cases was compared with the incidence of occupational asthma reported to the Finnish Register of Occupational Diseases for the population of construction workers, industrial workers and employed people of the entire country in 1995 [11].

We randomly selected a group of 100 asthmatic construction workers and examined their hospital records. The occupation, atopy and smoking habits at the time of diagnosis were noted.

Results
In the Tampere University Hospital, there was a total of 3659 new cases of asthma diagnosed in the population between the ages of 20 and 64 years in 1991–1995. Of these, 147 were construction workers and 29 were paper mill workers. The asthma diagnoses were extrinsic asthma (42%), intrinsic asthma (38%), other specified asthma (4%) and non-specified asthma (16%). Table 1 shows the number of people, the number of new asthma cases, and the ORs with 95% CIs for the male workers in the three groups.

The figures in Table 1 show a clear relationship between construction work and an increased risk of asthma. A slight dose–response relationship is apparent
between the duration of construction work and asthma frequency. The OR between paper workers and the general working age population was 0.8 (95% CI = 0.4–1.5) for women and 1.0 (95% CI = 0.6–1.6) for men. The age-specific risk for asthma was almost the same for the paper workers as for the general population. In the oldest age group of paper mill workers, there was an increased risk of asthma. The annual rate per 10^5 cases of asthma was 373 for the construction workers, 216 for the paper workers and 276 for the general working age population of the Pirkanmaa region.

According to the hospital records (random sample, 100 workers), there were positive findings in the prick tests of 45% of the asthmatic construction workers. There were positive reactions to animal dander in 27%, pollen of trees in 19%, hay pollen in 31%, house dust mite in 12% and moulds in 2%. Thirty-eight per cent were active smokers, 31% were ex-smokers and 25% had never smoked. The distribution of the occupational titles of the asthmatic construction workers was compared with that of the trade union of construction workers in Pirkanmaa. There were more asthmatics among the concrete workers, non-specified construction workers, insulators, pipe-fitters and painters (P < 0.05 for all these groups) than in the other occupational subgroups. The incidence of occupational asthma among the construction workers was lower than that of the other occupational groups (Table 2).

### Discussion

Our data indicate that the risk of asthma is increased among construction workers when they are compared with workers in the paper industry or the general working age population. This study was based on newly diagnosed asthma cases, and thus selective withdrawal from the active workforce because of disease had not yet significantly affected the numbers of construction workers. However, it is possible that some of the workers may already have changed their occupation before the definite diagnosis, and therefore the numbers may have given an underestimate. The total incidence of asthma was slightly overestimated because the group of non-specified asthma cases also included cases of suspected asthma, which may later prove to be other diseases, e.g. chronic obstructive pulmonary disease. These cases comprised <10% of all the cases of asthma and did not interfere with the comparison between different occupational groups in Pirkanmaa because all the cases were defined in the same way.

The inclusion criteria for the construction workers

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**Table 1.** Odds ratios and 95% CIs for male workers in the three occupational groups

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Pirkanmaa</th>
<th>Construction workers in Pirkanmaa</th>
<th>Paper workers in Pirkanmaa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>New asthma cases</td>
<td>n</td>
</tr>
<tr>
<td>20–34</td>
<td>42 483</td>
<td>375</td>
<td>3392</td>
</tr>
<tr>
<td>35–49</td>
<td>47 914</td>
<td>370</td>
<td>2950</td>
</tr>
<tr>
<td>50–64</td>
<td>32 804</td>
<td>463</td>
<td>1171</td>
</tr>
<tr>
<td>Total</td>
<td>123 201</td>
<td>1208</td>
<td>7513</td>
</tr>
</tbody>
</table>

**Table 2.** Incidence of reported cases of occupational asthma in different occupational groups in 1995

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No. of reported cases of occupational asthma in 1995</th>
<th>No. of employed people in 1995</th>
<th>Annual rate per 10^8</th>
<th>Relative risk in comparison with construction workers (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction workers</td>
<td>6</td>
<td>115 000</td>
<td>52</td>
<td>–</td>
</tr>
<tr>
<td>Industrial workers</td>
<td>95</td>
<td>456 000</td>
<td>208</td>
<td>3.99 (1.86–8.56)</td>
</tr>
<tr>
<td>All employed people in</td>
<td>426</td>
<td>2 068 000</td>
<td>206</td>
<td>4.12 (1.96–8.66)</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are from the *Statistical Yearbook of Finland* 1991 except Finnish Register of Occupational Diseases [11].
were limited in our study to employees whose working period was able to produce new asthma cases in the 1990s. The definition for a construction worker allowed a delay between the beginning of asthmatic symptoms and the diagnosis. If we had taken into account only workers who were still working in the 1990s, the number of new asthma cases would have been lower and the risk slightly lower. However, the conclusion would have remained the same; the risk of asthma among construction workers would have been 1.5 (95% CI = 1.2–1.8) times higher than among the general working age population.

Although construction work was associated with an elevated risk of asthma, it is not likely that construction workers are predisposed to asthma for genetic reasons or because of lifestyle; instead, this trade, with physically demanding jobs, is available mainly to workers with good respiratory health. Active smoking is known to double the risk of asthma [16], but also contradictory results have been shown [17,18]. In our study, asthmatic construction workers smoked slightly more than the general population, 38% being smokers at the time of the diagnosis of asthma, as opposed to 33% of the Finnish male inhabitants in 1995 [19]. Atopy also had no effect on the numbers, since 45% of the construction workers with asthma had atopy defined by positive findings in a prick test and this rate is not greater than that of Finnish asthma patients.

The reported annual rate of occupational asthma was lower for construction workers than for industrial workers or for all occupations. From other studies, we know that about one-third of the eczema cases due to occupational exposure to chromium and most of the asymptomatic cases of asbestos disease remain unreported among construction workers [12,13]. It is also a recognized fact that the coverage of occupational health services is half that of other industries. This underprovision would also lead to the under-reporting of occupational asthma. Thus, it is possible that occupational dusts or chemicals cause more asthma than indicated by statistics. On the other hand, clinical experience indicates that only a few cases of asthma meet the strict criteria of an occupational disease [20,21]. In addition, construction workers are exposed to many sensitizing agents, and they are also exposed to many irritants. These risk factors may interact to produce the work-related respiratory outcome of exposed workers. Therefore, it can be difficult to define a single causative agent for asthma at the individual level [5]. This non-specific, possibly irritant effect of the working environment may explain the excess of risk for general asthma. In addition, exposure to sensitizing agents at work may aggravate previously existing asthma or slight asthma symptoms that develop as a result of other types of exposure. Because this worsening effect possibly causes problems for construction workers, they may actively seek the aid of a physician and medication, the result being higher rates in asthma statistics.

The results indicate that insulators, pipe-fitters, concrete workers, non-specified construction workers and painters have a higher risk of asthma than other construction workers. In a new Finnish study based on national statistics, an elevated relative risk was found for asthma among electrical workers, woodworkers, painting and lacquering workers, and other construction workers [5]. In a further analysis of this study, published in 2002, all Finnish male construction industry workers and all those employed in administrative work were followed for asthma incidence through a register linkage in 1986 through 1998. Age-adjusted relative risks were increased in nearly all construction occupations studied, but the relative risk (RR) was highest among welders and flame cutters (RR = 2.34), asphalt roofing workers (RR = 2.04), plumbers (RR = 1.90), and bricklayers and tile setters (RR = 1.83) [22]. The results of this study are similar to our results, and strengthen the observed association between exposure in construction work and risk of asthma.

Painters may also be exposed to specific sensitizers, such as diisocyanates, isothiazolinone, formaldehyde or epoxides. In a previous study, painters were found to be at increased risk of airflow obstruction [23]. Wieslander et al. [24] found that the incidence of self-reported asthma among painters using water-based paints was slightly higher than that of an industrial population. In a study of insulation workers, occupational exposure did not seem to affect the risk of respiratory symptoms, but there was a positive interaction between occupational exposure and increased airway hyperreactivity [25]. In an American study among carpenters, exposure to cement, drywall and demolition dusts was associated with cement, drywall and demolition dusts was associated with.

Conclusions

This study shows that the risk of asthma in construction workers is higher than in the general working age population, although the number of reported cases of occupational asthma is lower. Additional studies are needed to determine the causative agents of asthma in construction work and the role of the effect of non-sensitizing irritants on the development of asthma. Work-related asthma seems also to include asthma with mechanisms other than sensitization.

Acknowledgements

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References


