Upper limb disorders among coopers in the Scotch whisky industry

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Background Coopering is a physically demanding trade which has existed for >500 years. Anecdotal clinical evidence suggested increased prevalence of upper limb disorders in the population of coopers in one organization.

Aims To investigate the prevalence of upper limb disorders in coopers and non-coopers. To identify differences in prevalence, and any relationship between the findings and the work practices.

Method Cross-sectional study of 108 coopers and 110 non-coopers. The Standardized Nordic questionnaire for the analysis of musculoskeletal symptoms was administered to all participants, who also underwent a clinical assessment for upper limb disorders.

Results Coopers were more likely to report elbow pain in the past 12 months (OR 3.4; 95% CI: 1.8–6.2) and pain in the last 7 days (OR 4.7; 95% CI: 2.0–8.9) and this was likely to lead to prevention of activity in the past 12 months associated with the elbow (P < 0.05). Clinical evaluation highlighted a higher prevalence of upper limb disorders in coopers (OR 9.8; 95% CI: 3.9–24.3) with epicondylitis predominating (OR 8.4; 95% CI: 2.8–25.0). There was also a higher prevalence of problems in the wrist and hand among coopers (OR 8.15; 95% CI: 1.04–64; P = 0.03). Logistic regression analysis confirmed the risk of upper limb disorder in coopers (P < 0.03) accounting for age (P < 0.05) and years of service (P > 0.25).

Conclusions Coopers appear to be at an increased risk of upper limb disorders. Work practices have been reviewed and a number of changes have been implemented to reduce this risk. Further study of this group is merited in future to determine the effect of changes in work practice on the risk of upper limb disorders.

Key words Cooper; epicondylitis; occupational; upper limb disorder.

Introduction Coopering is a trade that has existed for >500 years.

It involves using long curved pieces of wood (staves), to make whisky casks. Coopers use various automated woodworking machines, e.g. circular saws, band saws, spindle moulders and vertical boring machines during all stages of the cask assembly process. This ensures that the staves are shaped and edged appropriately.

Once the basic cask wood is assembled in this way, the cooper commences a cycle of shaping and fastening the barrel together, using temporary metal hoops to hold the wood in place and then hammering in place permanent hoops or metal bands. This is a skilled occupation and has an apprenticeship of 4 years.

The work of the cooper may result in health problems, for instance asthma or nasal cancer. One pilot survey on health problems in coopers was carried out by Standen [1] but this did not mention work-related upper limb disorders.

Clinical assessment in an Occupational Health Service identified problems such as tendonitis, epicondylitis and carpal tunnel syndrome within the population of coopers.

There is a high standard of health and safety training within the cooperage environment of the study company, but there was no specific advice or training given on the avoidance of upper limb disorders, as causative factors have not been clearly defined.

Upper limb disorders are often ascribed to jobs involving repetitive movements and intensive use of the hand or upper extremity, there is also a multifactorial aspect to these symptoms, including environmental, sociocultural...
and personal characteristics [2,3]. Occupations reported as causing upper limb disorder include tomato growers [4], carpenters [5], vehicle manufacturing operatives [6], music students [7], bank employees [8] and sewing machine operators [9].

Although previous studies have identified the effects of precision grip and force as risk factors in the development of work-related upper limb disorders [10], there are no specific studies that have targeted coopers as a group. In the absence of evidence from previous studies, it was decided to undertake a study of the cooperage industry within one company.

**Methods**

The null hypothesis was, ‘that coopers in the Scotch whisky industry have no increased rate of upper limb disorders, when compared with a group of General Workers’.

The questions asked by this study were:

(i) What was the prevalence of upper limb disorders among coopers?

(ii) What was the prevalence of upper limb disorders among General Workers?

(iii) Was there a difference in prevalence of upper limb disorders between the group of coopers and the group of controls?

(iv) What was the relationship between the clinical findings and the work practices performed?

A cross-sectional study was undertaken. The participants, all male, were from a single organization, based at five cooperages and warehouses throughout Scotland. All the 112 coopers working in the organization were included in this study.

This study was undertaken in 1998 before Committee on Publication Ethics (COPE) guidelines were available in 1999 and formal ethical approval was not sought.

The questionnaire was administered personally by F.M., who explained to each individual the nature and purpose of the questionnaire and the subsequent clinical examination and that the results would be analysed for a scientific paper.

Individuals were informed that they did not have to take part and could refuse without any concerns. The trade unions were involved before hand and were happy to support this study as they had concerns about the prevalence of upper limb disorders in the population. They actively encouraged their membership to become involved and they received no complaints or adverse comments about the process undertaken.

Four coopers who had been on sick leave for >3 months were not included in this study. For comparison, a group of workers was selected from individuals who worked in the same environment as the coopers, but whose work activities involved general cleaning duties and disgorging (emptying) the whisky barrels into blending troughs. One hundred and ten of these employees were selected sequentially from those who attended for routine health surveillance.

The study was undertaken using a modified version of the Standardised Nordic questionnaire [11,12] for the analysis of musculoskeletal symptoms.

This questionnaire has been identified as having a high degree of reliability and is suitable for use in epidemiological studies [13]. The questionnaire was administered to the study group on an individual basis, by one specific interviewer. Subsequently, each individual had a clinical examination carried out by the same doctor and any positive findings were noted in a structured *pro forma*. A diagnosis was based on standardized diagnostic criteria, from work published by Hutson [14]. The *pro forma* and diagnostic criteria also compare favourably with a study on case definitions established for work-related upper limb disorders [15].

The subjects were categorized into two groups of coopers and non-coopers for most analyses.

Results were analysed using non-parametric analysis (chi-squared tests) and logistic regression analysis. Relative risk of developing an upper limb disorder was estimated by odds ratios (ORs) [with 95% confidence intervals (CIs)].

**Results**

There were more non-coopers than coopers in the age group of 25–34 years and the non-coopers appear to have a younger age group pattern. The mean age for coopers was 39.2 years (SD = 9.6) and for non-coopers 36.9 years (SD = 9.2). There was a statistically significant difference between the ages of the two groups, coopers being older than non-coopers (P < 0.01).

The mean of the length of service for a cooper was 18.0 years (SD = 6.7), while the mean of the group of non-coopers was 7.1 years (SD = 6.6). Coopers have a statistically significant longer length of service than non-coopers (P < 0.001).

Results showed that there was no significant difference between neck, shoulder and wrist symptoms reported by coopers and non-coopers.

When comparing the symptomatology reported in the two study groups, coopers were more likely to report elbow symptoms over the last 12 months (44%), than non-coopers (19%), (P < 0.001) (see Table 1).

A similar pattern emerged when elbow pain in the last 7 days was analysed [OR 4.7; 95% CI: 2.0–8.9 (P < 0.005)].

Coopers also reported more reduction of activity in the last 12 months and when compared with the control group, there was a statistically significant number of coopers with restricted movement of elbows (P < 0.05).
There was also a higher rate of diagnoses in the group of coopers than in the group of non-coopers. This was particularly apparent in the wrist/hand and elbow areas, where epicondylitis and tendonitis predominated (see Table 2).

When the diagnosis of epicondylitis was analysed, there was a statistically significant difference between coopers and non-coopers (OR 8.4; 95% CI: 2.8–25.0).

The two study groups were then analysed as to the presence or absence of any type of upper limb disorder. This allowed increased group sizes for analysis, but had the disadvantage of not looking at specific anatomical areas. It was discovered that 39 (36.1%) of coopers had some type of upper limb disorder, whereas only six (5.5%) of non-coopers had an upper limb disorder (OR 9.8; 95% CI: 3.5–24.3; \(P < 0.001\)).

These results provide evidence to the cooperage industry that coopers are at a risk of developing upper limb disorders during the course of their working life.

Logistic regression analysis confirmed the risk of upper limb disorder in coopers (\(P < 0.03\)) when accounting for age (\(P < 0.05\)) and years of service (\(P > 0.25\)).

### Discussion

Our study found a significantly higher prevalence of reported elbow symptoms and epicondylitis among coopers compared with a group of non-coopers. We did not find a difference in the level of reported symptoms at other sites in the neck and upper limb. The finding of differences in elbow pain between the two groups may be related to work practices, as coopers are often involved in forceful hammering with the upper arm in a raised position. In cask assembly or repair, many tasks involve flexion and extension of the elbow joint. Wrist flexion, extension and rotation are also seen frequently during a cooper’s working practices and as a result symptoms of discomfort around the elbow joint might be expected to be frequently experienced.

Although the study was designed carefully to remove as many confounders as possible, there are some factors that may have introduced a degree of bias to the findings. Selection of the non-coopers, operator bias, or recall bias of the subjects themselves might have influenced the results obtained.

### Table 2. Numbers of subjects with ascribed clinical diagnosis—neck and upper limb

<table>
<thead>
<tr>
<th>Area of body</th>
<th>Cooper total</th>
<th>Non-cooper total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>67 (62%)</td>
<td>41 (38%)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>64 (59%)</td>
<td>80 (71%)</td>
</tr>
<tr>
<td>Elbows</td>
<td>60 (56%)</td>
<td>89 (81%)</td>
</tr>
<tr>
<td>Wrist/hands</td>
<td>67 (62%)</td>
<td>75 (68%)</td>
</tr>
<tr>
<td>Wrist</td>
<td>22 (20%)</td>
<td>26 (24%)</td>
</tr>
<tr>
<td>Elbow</td>
<td>36 (33%)</td>
<td>26 (24%)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>10 (9%)</td>
<td>5 (5%)</td>
</tr>
</tbody>
</table>

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Although a well-validated questionnaire was used, Franzblau et al. [13] carried out a study to evaluate the test and re-test reliability of this questionnaire. The Kappa values were all in the good to excellent range, which suggested that this questionnaire was reliable and suitable for use in epidemiological studies. The sensitivity and specificity of this tool however requires further evaluation.

The group of controls used in this study was the group of general workers and warehousemen in the cooperage industry. This group is involved in heavy manual handling tasks, i.e. rolling casks and loading them into lorries, as well as general cleaning up duties. Although no part of their task involves use of hand-held tools, the physical nature of their employment might have an effect on the results obtained in this study. This might have increased the likelihood of members of the control group developing upper limb disorders and reducing the significance of the finding of confirmed upper limb disorders when comparing the two study groups.

The group of controls in this study also had a significantly younger population than the group of coopers. Peak of muscle strength occurs at the age of 20–30 years [16] and decreases at 4–5% per year [17]. The assumption could be made that the younger the population, the fewer musculoskeletal problems should develop. Multivariate analysis was used to take account of this matter.

Four employees on long-term sickness absence were not included in this study. Thus, the healthy worker effect may have introduced some bias into the study by eliminating some individuals who had a significant upper limb problem from the study.

If any of these individuals had suffered from an ascribed upper limb disorder, this would have increased the significance of the study findings.

Recall bias might well have influenced the results of the questionnaire, as the timing of symptoms might not be accurately recalled and symptoms out with the time scale might well have been reported as within the last 12 months. Alternatively, symptoms might have been forgotten.

The results of the study also rely on the subjects reporting symptoms accurately. Both subject groups are in a traditional working environment, which perceives admission of any medical problem as a sign of weakness. An additional questionnaire assessing psychological factors among the subjects would have assisted in understanding any impact of these factors on the data collected.

This was not possible due to the cultural background of the cooperage at this time, which was not amenable to a questionnaire on psychological issues.

It is not therefore possible to accurately assess the impact of either psychological factors or the cultural aspects of the industry, on the outcome of this study.

Based on the results of this study, further work is ongoing to evaluate specific risk factors and work practices within the company.

Working groups have been formed within the company comprising of coopers, engineers, managers, health and safety advisors and occupational health advisors.

In light of the working party recommendations, working practices have been changed, rotations of role are being trialled, the bonus system is being phased out and mechanization of some aspects of the coopering process has been introduced. The coopers themselves are now trained and educated in best practices and techniques, in an attempt to reduce some of the risk factors involved in the tasks they perform.

The results from this study showed that coopers suffer more upper limb disorders than non-coopers.

The tasks undertaken as a cooper appear to be linked to the increase in prevalence of upper limb disorders and require further investigation.

Conflicts of interest

None declared.

References

12. Dickinson CE, Campion K, Foster AF, Newman SJ, O’Rourke AMT, Thomas PG. Questionnaire development: an


