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# SURVEY OF EXPOSURE TO HAND-ARM VIBRATION IN GREAT BRITAIN

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## ABSTRACT

The results of an investigation, carried out between 1984 and 1986, into the number of people in selected manufacturing sectors, the public utilities, agriculture, forestry and construction using powered tools associated with the incidence of vibration-induced white finger (VWF) are presented. The methods used to obtain the data are described and the significance of the results discussed. The findings suggest that there is a significant potential VWF problem. For the above industries combined, excluding construction, in any working week in 1985/86, about 130,000 workers were engaged in the specified processes for relatively long periods. For construction, on any working day in 984/85, about 22,000 workers were using the specified tools all day.

## INTRODUCTION

The purpose of the study was to give an indication of the likely extent of the problem in Great Britain, to identify processes and activities where further investigation of vibration exposure might be needed and to lay the foundation for the development of an HSE policy on hand-arm vibration. Surveys of three further sectors are being considered to obtain a more complete picture. These are railways, mining and quarrying and possibly Local Authority Direct Labour Organisations.

The main objectives were to:

(a) estimate the number of those using powered processes associated with VWF and therefore at possible risk of VWF;

(b) rank the specified vibration activities according to the number exposed and thus help to establish priorities for action;

(c) identify other powered processes in the industries surveyed which expose the hands of their operators to vibration and estimate the number of persons involved.

This paper is confined to (a) and deals with it in brief. A detailed report on the entire survey has been published by HSE [1].

The powered tools and processes which have been associated with the incidence of VWF (to varying degrees) in the sectors of industry covered by the survey are:

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**Manufacturing**

(i) Powered percussive metal working

- Riveting and holding up
- Caulking or chipping hammers
- Other fettling tools - eg scalers
- Pneumatic clinching and flanging
- Other hammers - eg impact wrenches and rammers
- Swaging

(ii) Grinders and other rotary tools used on metal and other material

- Pedestal grinders
- Hand-held grinders - eg straight, angle, vertical and swing
- Hand-held polishers (including sanders)
- Fixed linishers and polishers
- Rotary burring tools

(iii) Powered tools used on material other than metal

- Hammers, chisels and picks
- Rock (etc) drills
- Concrete vibro-thickeners (including pokers)

(v) Other processes and tools

- Shoe pounding-up machines

**Public utilities**

(i) Road and concrete breakers, including spaders picks etc

(ii) Chain saws

(iii) Hand-held grinders

(iv) Heavy duty industrial drill-hammers

**Agriculture and forestry**

(i) Chain saws

**Construction**

(i) Road and concrete breakers, including spaders, picks etc

(ii) Road drills, including air leg drills

(iii) Heavy duty industrial drill-hammers

(iv) Vibrating pokers.

## METHOD

It is reasonable to assume that those who use these tools and processes may be at risk of VWF although the degree of risk will depend on, amongst other factors, the vibration of the particular tools used and the extent of the exposure. To estimate the number involved in their use the following methods were adopted:

**Manufacturing**

Randomly selected establishments or targeted establishments, from the five sectors likely to use the powered tools or processes of interest most, were visited between January 984 and April 1986. For practical reasons establishments rather than employees were selected and the data collected related to all manual workers employed there. The manufacturing sectors were:

(a) Foundries and steel making;

(b) Ship building, ship repairing and oil rig construction;

(c) Mechanical engineering and vehicle manufacture;

(d) Concrete products; and

(e) Wire and rope manufacture and footwear where hammer swaging and shoe pounding-up machines were of particular interest. HSE Inspectorate Groups with national responsibility for these specialised small sectors identified all establishments known to be using these machines for visiting.

Factory Inspectors carried out the visits, which averaged 12 per month and completed a proforma during each visit.

### Public Utilities

The number of persons using relevant tools in the public utilities was estimated with the help of the Health and Safety Committee of the National Joint Utilities Group (NJUG). Each utility's representative on the Health and Safety Committee made arrangements for a survey to be carried out in a sample of its Areas, Regions or Authorities. The procedures used to gather the data were determined by individual utilities and depended on their organisational structure. HSE's only involvement was to explain the objectives and background to the investigation and provide standard proformas.

Data were collected for a whole week during the second and third week in May 1985. In the case of electricity the exercise was repeated during week beginning 7 April 1986 because the initial data proved to be insufficient. Contract labour was excluded but this should have been covered by the survey in the construction sector. Private water companies were taken into account in computing the national estimates.

### Agriculture and forestry

To estimate the number using chain saws, HSE's Agricultural Inspectors visited a sample of agricultural establishments and forest locations during the period of January to April 1986 and completed a proforma for each. For practical reasons, as in the case of manufacturing, premises rather than employees were selected and the data collected related to all manual workers employed there.

The number using chain saws on Forestry Commission (FC) forests was obtained separately by the FC using HSE's proforma. All their districts were surveyed during week beginning 17 March 1986.

### Construction

To estimate the numbers involved we had hoped to study a randomly selected sample of construction sites. This, however, was not possible because of the emphemeral nature of construction work; nor was it possible to devise satisfactory arrangements, as in the case of the manufacturing sector, to have the data gathered by Factory Inspectors during their normal day to day inspection work. Estimates were based on data obtained from 379 sites belonging to 12 of the larger construction firms in Great Britain who agreed to help. Participating firms visited all their sites between July and October 1984.

## SAMPLING

### Manufacturing

With the exception of wire and rope manufacture and footwear, where all establishments known to be using the machines of interest were to be visited, the aim was to visit 1% of establishments. The samples achieved were in the region of 1.5% for establishments and for workers 1.6 to 5.1%, both sets being higher than intended.

### Public utilities

The samples chosen were as follows:

| | |
|---|---|
| Electricity | 2 of the 14 Area Boards |
| Gas | 2 of the 12 Regions |
| Water | 3 of the 10 Authorities |
| British Telecom | 48 of the 61 Areas |

The Health and Safety Committee felt that these samples could be used to provide an order of magnitude estimate of the number who used tools in the specified categories.

### Agriculture and forestry

To make less demands on HSE's Agricultural Inspectorate resources it was decided at the outset not to use a specially selected random sample but rather to rely on visits to premises appearing on inspectors' basic inspection programme. However, the premises to be included in the survey were to be those visited first on any one day irrespective of whether or not chain saws were being used. Naturally the sample included forest locations but FC premises were to be excluded. We reckoned that by asking Agricultural Inspectors to complete at least two proformas per week during a four month period enough establishments would be sampled in both agriculture and forestry to allow national figures to be estimated. FC estimates were not based on sample data but on information from all their forest districts and research units. The samples achieved were 1.3% of agricultural and 5.2% of forestry (excluding FC property) employees.

### Construction

Although clearly not a fully representative sample we think that the 379 sites visited can at the very least be used to give an order of magnitude estimate of the number who were using powered tools in the specified categories. This is because:

(i) the data collected at each site included the workers of sub contractors and all other manual workers on site as well as those of the main contractor. Sub contractors, large and small, and others are brought in as and when necessary by the main contractor so the data collected should contain information relevant to most kinds of construction work.

(ii) the size and type of site covered are thought likely to be representative of the industry.

## COLLECTING DATA

### Manufacturing

The information was collected by inspectors using a standard proforma. It contained background information about the survey and the interpretation of the questions, followed by questions to place the source of the data, the week in which they were collected and the establishments' industrial classification. Further questions asked for the total number of workers engaged on vibration activities in 17 specified categories during the week of the survey, accompanied by a breakdown, in a table such as that shown below, of how long the activities were performed.

| Days/week | Number of persons | | |
|---|---|---|---|
| | Up to half hour/day | Half to 4 hours/day | More than 4 hours/day |
| 1 day or less | | | |
| 2 or 3 days | | | |
| 4 days or more | | | |

Such a table also had to be completed for each group of workers or individuals engaged on only one tool (or one category of tools).

The proforma was designed to distinguish between those using only one tool, or one category of tools, and those (groups or individuals) using tools in more than one category. For the latter information a simplified table was devised.

### Public utilities

The proforma for this part of the survey was very similar to that used in manufacturing. The main differences being the list of specified tool

categories, and the table to account for workers using more than one category which was essentially the same as for single category users.

**Agriculture and forestry**

Only chain saws were specified on this proforma so it was simpler and did not need to address the question of workers using more than one tool category.

**Construction**

The proforma used in the construction survey was designed to reflect the fact that the data collected were to be for single days rather than whole weeks. It required the total number of manual workers at work on site on the day of the visit and the number using the specified powered tools, accompanied by a breakdown which showed how long they had used the tools on that day. For each category a table such as that shown below had to be completed.

| | Less than half hour | Less than half day | All day |
|---|---|---|---|
| Number of person | | | |

Workers using more than one tool category were to be reported in separate but similar tables. (In the event this only appeared reliably twice). Apart from these differences the proforma was much the same as the others

## RESULTS

**Manufacturing**

Overall 28,107 manual workers were employed on the 330 premises visited of which 6,424 ie 23% of the sample, were engaged on the specified vibration activities. Just over half of the establishments were small employing 1 to 10 workers; only 21 were employing more than 200 workers. The largest establishment visited employed 5,969 workers of which 396 were using specified tools. Sixteen establishments were reported as employing one worker each. The largest number engaged on specified vibration activities was 895 workers employed at an establishment with a total workforce of 3,317.

The data were divided into low and high usage groups as shown below:

| Days/week | Number of persons | | |
|---|---|---|---|
| | Up to half hour/day | Half to 4 hours/day | More than 4 hours/day |
| 1 day or less | Low usage | | |
| 2 or 3 days | | High usage | |
| 4 days or more | | | |

The low usage group consisted of all those using tools for less than half an hour per day on some or all the days of the survey week and those using tools for half to 4 hours for 1 day. The remainder were placed in the high usage group; ie those using tools for more than 4 hours per day on some or all the days of the survey week and those using tools for half to 4 hours per day for 2 days or more.

We have estimated for the manufacturing sectors covered by the survey the number of workers in Great Britain who use specified category tools to be about 289,000. National estimates for the numbers in the low and high usage groups for each manufacturing sector were also made and are shown at Table 1. To obtain national estimates we used figures for the number of manual workers employed in each manufacturing sector, derived from Department of Employment statistics.

### Public utilities

The number of utility workers in our samples using specified tools was 3985. Manpower data provided by the utilities for the period of the surveys enabled us to gross up the results which showed the number of utility workers in Great Britain likely to be using tools in the specified categories at the time was about 9,000. Estimates for low and high usage groups for each category as well as for group totals are at Table 2.

### Agriculture and forestry

Overall, 3941 workers were employed on the agricultural premises visited of which 388, ie 10% of the sample, were engaged on chain saws. In forestry the overall number was 5506 of which 5195 were working on FC forests; about half were using chain saws.

We used data provided by the Department of Employment, MAFF and the FC to gross up the results. On this basis the number of agricultural workers in Great Britain likely to be using chain saws at the time of the survey

was about 29,000 and the number of forestry workers (excluding those working on FC land) was about 2,500. The number of workers using chains saws on FC land was 2,700. Estimates for low and high usage groups as well as for group totals are at Table 3.

**Construction**

The total number of manual workers on the 379 sites visited was 14001 of whom 1075 were using tools in the specified categories. Using data derived from the Department of Employment Gazette we estimated the total number of manual workers in the construction industry at the time of the survey and used this figure to gross up the results. This showed the number of construction workers in Great Britain likely to be using the specified tools in 1984 would be between 90,000 and 100,000. Estimates for the numbers using these tools for less than half an hour, less than half a day and all day are shown at Table 4.

## BASIS FOR CONCLUSIONS

29 We have assumed that the samples of premises visited were employing a sufficiently representative sample of workers, at least as far as the specified tools and processes are concerned, to allow broad estimates to be made. In the case of the public utilities and forestry, the Health and safety Committee of NJUG and the FC advised that the activities and the amount of work done in their respective industries are not in general season dependent unless conditions are extreme. Therefore the data for March, April and May are thought likely to be representative of activity throughout the year. This is also likely to be true of forestry work not controlled by the FC. In agriculture on the other hand it is HSE's experience that activities, not surprisingly, are season dependent with chain saw work increasing over the winter months and into spring. It was during some of these months ie January to April, that the survey was conducted so these data are probably only representative of periods of maximum usage. In construction, although activities are not in general season dependent unless conditions are extreme, more work is known to take place from about April to October and it was during some of these months, ie July to October, that the survey was conducted. Therefore the data collected were probably representative of the construction industry at times when more work is done.

## CONCLUSIONS

During any working week in 1985/86 the numbers of workers likely to be using tools or processes associated with the incidence of VWF were 289,000 in the manufacturing sectors surveyed, 9,000 in the public utilities and 5,000 in forestry. In agriculture the figure was 29,000 but this is probably only representative of periods of maximum usage, ie the winter months. In construction, for the majority of working days in 1984/85, the number of workers likely to be using such tools was 94,000 but may be lower

in winter months. These workers are potentially at risk of developing VWF but it is important to note that the number who may go on to develop the disease will be much less and will depend on many factors. In addition to vibration exposure these include the direction of vibration transmitted to the hand, the magnitude and direction of forces applied by the operator through his hands to the tool, the area and location of the parts of the hands which are exposed, individual susceptibility and climatic conditions.

It is generally accepted that the risk of VWF increases with the time for which tools are used. Of the 289,000 workers in the manufacturing sectors, 115,000 were in the high usage groups and 174,000 in the low usage groups. High and low usage group figures were, respectively, 4,000 and 5,000 in the public utilities, 4,000 and 1,000 in forestry, and 9,000 and 20,000 in agriculture.

While it is not possible to say whether the same workers used the tools in subsequent weeks, it seems reasonable to assume that most did, although in the case of agricultural work seasonal variations are particularly likely to affect both the numbers involved (in chain saw work) and the extent of usage.

Of the 94,000 workers in construction, 10,000 were using the tools for less than half an hour, 62,000 for less than half a day, and 22,000 all day. Again it is not possible to say whether the same workers used the tools on subsequent days but it seems reasonable to assume that most did.

## REFERENCES

K Kyriakides, Survey of exposure to hand-arm vibration in Great Britain, HSE Research Paper 26, ISBN 0 7176 0315 6

**Table 1 Manufacturing: national estimates of number of workers using one category of tools (or one tool) or more than one category by usage group and industry sector**

| Industries | One Category | | More than one Category | | Totals | | |
|---|---|---|---|---|---|---|---|
| | Low Usage | High Usage | Low Usage | High Usage | Low Usage | High Usage | Both Groups |
| Foundries and steel making | 1,200 | 2,000 | 7,300 | 8,400 | 8,400 | 10,400 | 18,800 ±1,100 |
| Ship building, repairing and oil rig construction | 4,100 | 5,700 | 18,700 | 2,900 | 22,800 | 8,600 | 31,400 ±1,500 |
| Mechanical engineering and vehicle manufacture | 86,300 | 60,900 | 51,100 | 33,000 | 137,400 | 93,900 | 231,300 ±5,900 |
| Concrete products | 3,800 | 1,200 | 2,200 | 600 | 6,000 | 1,800 | 7,800 ±1,200 |
| All above | 95,400 ±4,300 | 69,700 ±3,700 | 79,300 ±3,600 | 44,900 ±2,800 | 174,600 ±5,500 | 114,700 ±4,500 | 289,300 ±6,900 |

± Approximate 95% confidence intervals

Note 1: Figures may not sum to total because of independent rounding

Note 2: Low and high usage are defined at paragraph 23

Table 2 **Public utilities: national estimates of numbers of workers using one category of tools (or one tool) or more than one category by usage group and tool category**

| | Low usage groups | High usage groups | Totals |
|---|---|---|---|
| Road and concrete breakers (including spaders, picks etc) | 1,800 | 3,500 | 5,300 ± 210 |
| Chain saws | 280 | 350 | 630 ± 70 |
| Hand-held grinders | 300 | 160 | 460 ± 60 |
| Heavy duty industrial drill-hammers | 930 | 500 | 1,430 ± 110 |
| Category combinations | 370 | 760 | 1,130 ± 100 |
| All tools | 3,680 ± 180 | 5,270 ± 210 | 8,950 ± 270 |

Note: Low and high usage are defined at paragraph 23

± Approximate 95% confidence intervals

**Table 3 Agriculture and forestry: national estimates of the number of workers using chain saws by usage group**

| | Low usage | High usage | Both groups |
|---|---|---|---|
| Agriculture | 19,900 | 8,900 | 28,800<br>±2,700 |
| Forestry (excluding Forestry Commission) | 500 | 1,900 | 2,400<br>± 300 |
| All above | 20,400<br>± 2,400 | 10,800<br>±1,600 | 31,200<br>± 2,800 |
| Forestry Commission | 200 | 2,500 | 2,700 |
| Overall total | 20,600 | 13,300 | 33,900 |

± Approximate 95% confidence intervals

Note: Low and high usage are defined at paragraph 23

Table 4 Construction: national estimates of the number of workers using tools by tool category and duration

| | < Half hour | | < Half day | | All day | | Totals | |
|---|---|---|---|---|---|---|---|---|
| Road and concrete breakers (including spaders picks etc) | 1,600 | | 16,100 | | 9,800 | | 27,500 | 3000 |
| Rock drills (including air leg drills) | 400 | | 2,500 | | 1,600 | | 4,500 | 1200 |
| Heavy duty industrial drill-breakers | 7,200 | | 30,000 | | 9,300 | | 46,500 | 3900 |
| Vibrating pokers | 800 | | 13,600 | | 1,600 | | 16,000 | 2300 |
| All tools | 10,000 | 1800 | 62,200 | 4500 | 22,300 | 2700 | 94,500 | 5400 |

Approximate 95% confidence intervals