

Upper limb disability and exposure to hand-arm vibration in selected industries

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There is a need for evidence-based intelligence related to ill-health caused by exposure to vibration that could be used to benchmark the extent of disease and allow assessment of changes over time. This ideally requires simple, validated and cheap tools that can be administered easily across all industries. The Disability of the Arm, Shoulder and Hand (DASH) questionnaire is one instrument that may be useful.

The emphasis of HSE's Noise and Vibration Programme has been on the health outcome of hand-arm vibration syndrome (HAVS), which is by definition causally associated with cumulative hand-transmitted vibration exposure. However, individuals with HAVS may also have other musculoskeletal disorders, which may or may not be a consequence of vibration exposure, but that will contribute to their overall disability.

The study reported here involved the application of the DASH questionnaire to a population working with hand-held vibrating tools, whilst collecting simple information related to industry, trade, tools used, vibration exposure, known health problems and symptoms in the upper limbs. Following discussion with appropriate HSE colleagues four industries were selected for study: Gardening; Manufacture of Basic Metals, Construction and Motor Vehicle Repair.

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EXECUTIVE SUMMARY

There is a need for evidence-based intelligence related to ill-health caused by exposure to vibration that could be used to benchmark the extent of disease and allow assessment of changes over time. This ideally requires simple, validated and cheap tools that can be administered easily across all industries. The Disability of the Arm, Shoulder and Hand (DASH) questionnaire is one instrument that may be useful.

The emphasis of HSE's Noise and Vibration programme has been on the health outcome of hand-arm vibration syndrome (HAVS), which is by definition causally associated with cumulative hand-transmitted vibration exposure. However, individuals with HAVS may also have other musculoskeletal disorders, which may or may not be a consequence of vibration exposure, but that will contribute to their overall disability.

In the present study we applied the DASH questionnaire to a population working with hand-held vibrating tools, whilst collecting simple information related to industry, trade, tools used, vibration exposure, known health problems and symptoms in the upper limbs. Following discussion with appropriate HSE colleagues four industries were selected for study: Gardening (SIC 1.41-Agricultural service activities); Manufacture of Basic Metals (SIC 27), Construction (SIC 45) and Motor Vehicle Repair (SIC 50.2).

Some care must be taken about extrapolating the findings of this report given the low response rate (287 responses, 14% response rate).

Objectives

1. Use simple self-administered disability questionnaires to assess disability in the upper limbs of individuals who have worked with vibrating tools in Gardening, Manufacture of Basic Metals, Construction and Motor Vehicle Repair.
2. Establish whether there are any differences in disability score between industries.
3. Establish whether the disability score is related to the trade of the individual.
4. Establish whether the use of any particular tools is related to elevated disability scores.
5. Investigate whether the disability score is elevated in those individuals reporting health problems or presenting with symptoms.

Main Findings

1. There was no significant difference in median age adjusted DASH scores between the industries, despite differences in duration of vibration exposure (total hours or years) between the industries. However, there was a suggestion of a greater proportion of those with the greatest DASH values coming from the Manufacture of Basic Metals industry.
2. Of the trades investigated, those classified as SOC 9129 (Labourers in other construction trades) had the highest median DASH scores. However, the comparison across trades is restricted because of very small numbers in some trades.
3. There was no evidence in the study population that the use of any particular hand-held vibrating tool led to increased disability scores.

4. In this vibration exposed study population 7.4% reported being diagnosed with HAVS, 5.3% had an upper limb problem, 11.1% had a back or lower limb problem and 2.9% had some other problem not affecting the upper limbs. The outcome on the DASH questionnaire was responsive to both the upper limb problems and the HAVS diagnosis.
5. A large proportion of the individuals working with vibrating tools in this study reported symptoms including pain or problems in the hands/wrists (32.2%), arms (26.6%), shoulder (28.4%) or neck (27.7%). These proportions were similar to those reported in the MRC general population study from the United Kingdom. The proportion of the study group reporting blanching in cold conditions (20.2%) and waking at night with pain or tingling/numbness in the hands (24.1%) were higher than those reported in the MRC study. These upper limb symptoms were related to the disability score obtained from the DASH questionnaire, with the most important determinants being self-reported pain or problems with the hands/wrist or arms. The DASH outcomes in the working groups studied suggest that increases in the DASH score are particularly reflecting pain in the hand/wrists, and to a lesser extent the arms, rather than the classical neurosensory and vascular HAVS symptoms of tingling, numbness and blanching.

Recommendations

Simple questions related to pain in the various locations of the upper limb may be useful in health surveillance questionnaires, as this was found to be the main determinant of disability in this study population. From this study we would recommend that further work would be needed to ascertain the main determinants in other populations (e.g. those with a confirmed diagnosis of HAVS), and also to identify questions that may be useful in health surveillance.

Disability, as measured by the DASH questionnaire in this population, may be a consequence of vibration-induced HAVS, or other upper limb disorders also found in vibration-exposed workers. The relative proportion of non-HAVS related upper limb symptoms and disorders in this workforce using vibrating tools suggests that health surveillance should not ignore such non-HAVS related problems, especially those causing pain in such workforces.

The DASH questionnaire may be a useful tool for integrating, on a quantitative basis, the health problems caused by HAVS and upper limb co-morbidities that are found in significant levels in workforces using vibrating tools.

1 INTRODUCTION

Validated quantitative health outcome questionnaires may be a cheap, effective means of identifying and prioritising workplace hazards and identifying specific groups of workers who may require more detailed investigation. They could also be used as a measure for obtaining levels of disability associated with hand-arm vibration exposure in defined trades and, as such, may be used to target HSE's limited resources to those trades that may be more likely to benefit from intervention strategies. Furthermore, these questionnaires could be useful in monitoring the success of targeted interventions over time and be used to demonstrate HSE's success in delivering their reduction in ill-health targets.

The Disability of the Arm, Shoulder and Hand (DASH) questionnaire was introduced in 1996 and specifically focuses on disability in the upper limbs and its effect on everyday activities [1]. It was developed by the American Academy of Orthopedic Surgeons, the Council of Musculoskeletal Speciality Societies and the Institute of Work and Health in Toronto. The original goal of this collaboration was to produce a brief, self-administered measure of symptoms and functional status, with a focus on physical function, to be used by clinicians in daily practice and as a research tool [1]. This questionnaire has now been adapted and validated in a variety of languages including Dutch [2], German [3], Canadian French [4], Japanese [5] and Chinese [6]. It consists of 30 questions related to function of the upper extremity and two further optional modules related to work and social activity. A well described scoring procedure accompanies the questionnaire and normal values related to the general population of the United States have been published in the literature [7]. The questionnaire has been shown to have good construct validity, is responsive to changes in the upper limbs and is the only questionnaire available that looks at the whole of the upper limb, rather than its individual components [8]. It has been used widely to look at changes in the upper limb following surgery or treatment for a variety of conditions including Carpal Tunnel Syndrome [9], lateral epicondylitis [10], Dupuytren's contracture [11], peripheral nerve repair [12] and osteoarthritis in the hand [13]. Furthermore, the questions on the DASH questionnaire can be mapped to the World Health Organization's International Classification of Functioning, Disability and Health [3].

Excessive exposure to hand-arm vibration leads to well described symptoms of blanching in cold conditions, tingling/numbness in the hands and effects on manual dexterity and grip strength. However, little is known about the effect of this upper limb disorder (hand-arm vibration syndrome) on functionality or disability of the upper limbs. Furthermore, it was not known how disability was related to the current way in which the severity of HAVS is defined (Stockholm Workshop Scale). In a previous study we used the DASH questionnaire to assess upper limb disability in individuals diagnosed by a physician as having HAVS, and relate this to severity of disease. The quantitative outcome from this questionnaire was found to be related to the Sensory Stockholm Workshop Staging of individuals and also allowed exploration of comparative disability between HAVS cases, CTS cases and those cases with a diagnosis that indicated both HAVS and CTS combined [14, 15]. Interestingly, the DASH score was most related to the sensory component of HAVS, as opposed to the vascular component [14]. In addition, we have also shown that the best predictors of outcome on the DASH questionnaire are measures of manual dexterity (Purdue pegboard) and grip strength [16].

This work has shown that the outcome from this questionnaire provides useful health outcome information in those diagnosed with HAVS. However, it is currently unclear how this compares to a population working with hand-held vibrating tools, which do not have HAVS. Furthermore, the extent of upper limb disability arising from any cause (e.g. HAVS, Carpal Tunnel Syndrome) in a population working with hand-held vibrating tools is unknown.

The present study aimed to collect information on disability in the upper limb using the DASH questionnaire in a population working with hand-held vibrating tools in four industries. The industries of interest were Gardening (SIC 1.41-Agricultural service activities); Manufacture of Basic Metals (SIC 27), Construction (SIC 45) and Motor Vehicle Repair (SIC 50.2).

The main objectives were to:

1. Use simple self-administered disability questionnaires to assess disability in the upper limbs in Gardening, Manufacture of Basic Metals, Construction and Motor Vehicle Repair.
2. Establish whether there are any differences in disability score between industries.
3. Establish whether the disability score is related to the trade of the individual.
4. Establish whether the use of any particular tools is related to elevated disability scores.
5. Investigate whether the disability score is elevated in those individuals reporting health problems or presenting with symptoms.

2 METHODS

2.1 STUDY DESIGN

In this study we assessed the functional ability (disability) in the upper limbs and vibration exposure characteristics of a working population of individuals who had been exposed to hand-arm vibration in their jobs. The individuals were from four selected industries: Gardening (SIC 1.41-Agricultural service activities); Manufacture of Basic Metals (SIC 27), Construction (SIC 45) and Motor Vehicle Repair (SIC 50.2). These were classified according to the UK Standard Industrial Classification (SIC 2003 [17]). Every individual was sent a questionnaire to collect information regarding vibration exposure history, functionality/disability of the upper limbs and simple HAVS symptoms (Appendix one).

2.2 RECRUITMENT OF POPULATION

In order to recruit appropriate working populations we contacted Occupational Health Physicians and Nurses who had attended the Faculty of Occupational Medicine HAVS course and other personal contacts via letter and telephone to see if they would be willing to help in this research. We also presented the study to the Motor Vehicle Repair Forum and Northern Construction Group to raise awareness of the research and gain contacts. In addition, we also attended one of the Motor Vehicle Repair Safety and Health Awareness Days (SHAD), and a similar event in Noise and Vibration. In total we made 67 contacts and these consisted of 22 local authorities, 13 private Occupational Health Providers, 5 Construction firms, 3 Unions, 4 Trade Associations, 7 Foundries and 13 in the others category (e.g. vehicle manufacture).

This study received approval from the HSE Research Ethics Committee (ETHCOM/REG/05/04).

2.3 QUESTIONNAIRE DESIGN AND DISTRIBUTION

The questionnaire was designed in a software package available for these purposes (Sphinx Survey v4.5). The full questionnaire can be found at Appendix one but briefly it consisted of ten pages of questions, most of which were of the CROSS in the box design. The questions asked for information regarding age, gender, employment status, job history and industry, whether the individual had received a diagnosis of HAVS, signs and symptoms related to HAVS and/or Carpal Tunnel Syndrome, difficulties in performing everyday activities (DASH) and history of vibrating tool use. Information that could be used to identify individuals, such as the name and address of the person completing the questionnaire and the employers name, were not collected to protect anonymity and encourage individuals to complete the questionnaire. A cover letter was appended to the front of the questionnaire detailing what the study was for, how long it would take to complete the questionnaire and how to return the completed questionnaire. Each questionnaire was distributed with a FREEPOST envelope with the name and address of a member of the study team, so that individuals could return the questionnaire directly to HSL rather than through their management or Occupational Health system. The questionnaires were distributed to individuals through their management, health and safety representatives, or occupational health provider.

2.4 DATA MANAGEMENT

The completed questionnaires were scanned into the Sphinx survey software. This software is able to machine read the responses on the questionnaire and place the data into a database. Each entry was checked by the operator for accuracy and, if necessary, amendments were made.

2.5 DATA ANALYSIS

Calculation of Disability for the Arm, Shoulder and Hand (DASH) Score

The answers to questions 19 through to 48 (Appendix one) were used to calculate the DASH score. The DASH score has a range of values between 0 and 100, with 0 depicting no lack of function or disability and 100 depicting maximal disability. This was calculated according to the documentation that accompanies the DASH questionnaire; missing answers were handled as recommended. A normalized score (mean=50, standard deviation =10) compared to the reference values for US males was also calculated according to the scheme of the American Academy of Orthopaedic Surgeons [7].

Age adjustment of DASH score

The DASH score is related to age in the published reference data for US males. To account for this the normalised DASH score was adjusted to an age of 45years as published previously [16]:

$$\text{DASH}(\text{adj}_{45}) = \text{Measured DASH} - [46.84 - (0.03976 * \text{age}) + (0.001802 * \text{age}^2)] + 48.7$$

It is the age-adjusted normalised score that has been used throughout the majority of the report and included in the statistical analysis.

Calculation of total duration of vibration exposure over the working lifetime

Individuals were asked to complete a questionnaire regarding the extent of use of vibrating tools during their working lives (Appendix one). They were asked to estimate the trigger time per day and the total number of years a tool had been used. The reported number of hours per day and total number of years a tool had been used were then used to calculate the total number of hours a tool had been used over the working life. The total number of working days a year was estimated as 221. The total number of hours a tool was used was estimated according to the following:

$$\text{Total hours of use} = (\text{Hours per day} * 221) * \text{number of years used}$$

This was calculated for each type of tool used. The total values for each type of tool were then summed to give the total lifetime hours of tool use.

Standard coding of industry and trade

Using the information collected regarding job history and industry (questions 8 and 9 respectively of Appendix one) the industry and trade in which each individual worked was coded according to the UK Standard Industrial Classification of Economic Activities 2003 (SIC 2003) [17] and the Standard Occupational Classification 2000 (SOC 2000) [18].

Definition of subgroups within the working population with reported health problems or symptoms

The influence of specific symptoms and reported health problems on the DASH score was investigated by grouping individuals according to the answers given on the questionnaire.

Those individuals who reported a health problem in question 53 ('Do you have any other health problems that you think are important?') or answered 'Yes' to question 10 ('Have you ever been diagnosed as having hand-arm vibration syndrome (HAVS) or vibration white finger (VWF)?') were defined as the group with self-reported health problems. These problems were then subdivided into those related to the upper limbs, back/lower limbs, HAVS or Other.

We also looked at whether individuals experienced any symptoms or pain that may affect their functionality. If an individual answered 'Yes' to any one of the following questions they were defined as the group with self-reported symptoms:

- Question 11 Have your fingers gone white on exposure to cold?
- Question 14 Do your fingers tingle for more than 20 minutes after using vibrating equipment?
- Question 16 Do your fingers go numb for more than 20 minutes after using vibrating equipment?
- Question 18 Do you ever wake from sleep with any pain, tingling, or numbness in your hands/wrists or arms?
- Question 49 In general, have you pain or problems with your neck?
- Question 50 In general, have you pain or problems with your shoulders?
- Question 51 In general, have you pain or problems with your arms?
- Question 52 In general, have you pain or problems with your hands/wrists?

2.6 STATISTICAL ANALYSIS

The data were exported from Sphinx survey into SPSS for the purposes of statistical analysis. Distribution of all variables was checked before conducting statistical analysis. The DASH score and measurements of total lifetime hours of tool use were not normally distributed. The measurements of total lifetime hours of tool use were successfully transformed to approach normality by calculating the following: $\log_{10}(\text{total lifetime hours of tool use}/100)$. It was this transformed data that was used in the analysis. However, standard transformations were unable to transform the DASH data satisfactorily, therefore these data have been treated non-parametrically.

Non-parametric grouped data are presented in the report as Box and Whisker plots and medians were compared using the Mann-U-Whitney test. Multiple comparisons of medians were unadjusted unless otherwise stated.

Where the relationship between two continuous variables was examined correlation analysis was performed and Pearsons correlation coefficient presented with corresponding p-value.

The proportion of individuals with symptoms in different industries, or with different self-reported health problems, was compared using chi-squared analysis.

Predictive models were created to establish which of the questions regarding symptoms or pain were most predictive of the DASH score. Univariate general linear regression in SPSS was used for this purpose. Firstly all of the questions were put in the model and then on a systematic basis each one that was not statistically significant was removed from the model. The final model contained only those variables having a significant contribution, and the significance level and partial Eta Squared (proportion of total variability attributable to a factor) for each variable was reported. The overall adjusted R squared value for the final model was also reported. The residuals for the model were also examined to ensure that this analysis was appropriate.

3 RESULTS

3.1 QUESTIONNAIRES RETURNED AND RESPONSE RATE

Of the 67 companies/professionals we contacted to see if they would help with this study, 13 agreed to help (19%). These constituted 5 councils, 3 construction firms, 2 unions, 1 foundry, 1 private occupational health provider and 1 other.

A total of 1,987 questionnaires were sent out to these contacts and we received 287 responses, which was equivalent to a 14% response rate.

3.2 OVERVIEW OF THE DATA AVAILABLE

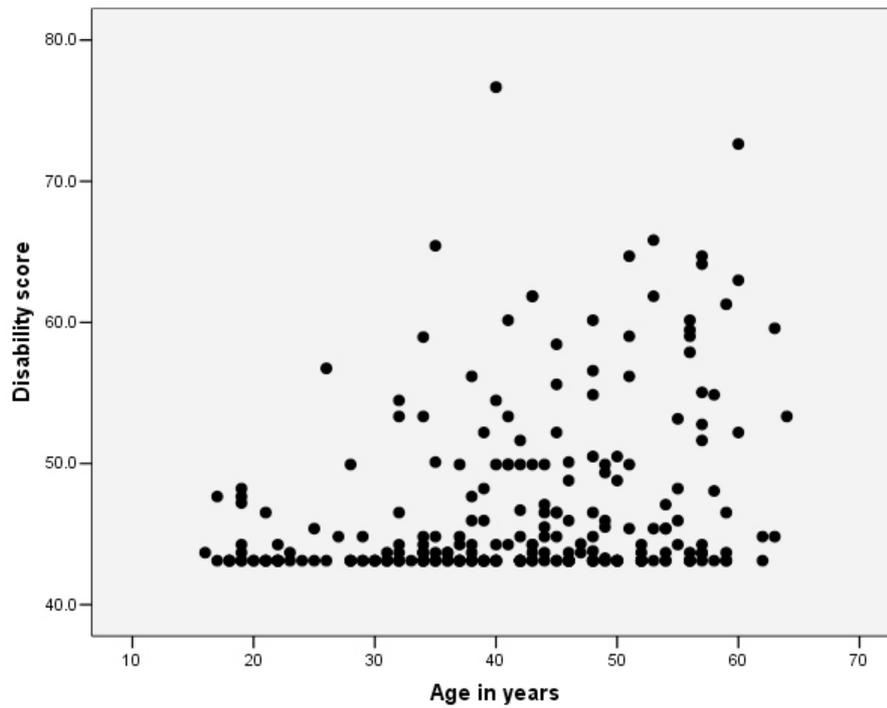
Of the 287 questionnaire responses we received from the study population 18 of these were from individuals who had never used vibrating tools occupationally and these were therefore excluded from further analysis. A further 23 were excluded because they did not work in the industries selected, or information regarding the industry they worked in was not available. Of these 3 individuals did not complete the DASH questionnaire appropriately and this gave a total of 243 DASH questionnaires that were available for analysis. These responses came from the following industries: Gardening (n=35); Manufacture of Basic Metals (n=11); Construction (n=106) (67 of these in road construction) and Motor Vehicle Repair (n=91).

Of the 243 individuals included in this study 227 currently used vibrating tools and 16 used them in previous jobs.

3.3 RELATIONSHIP BETWEEN AGE AND DISABILITY SCORE

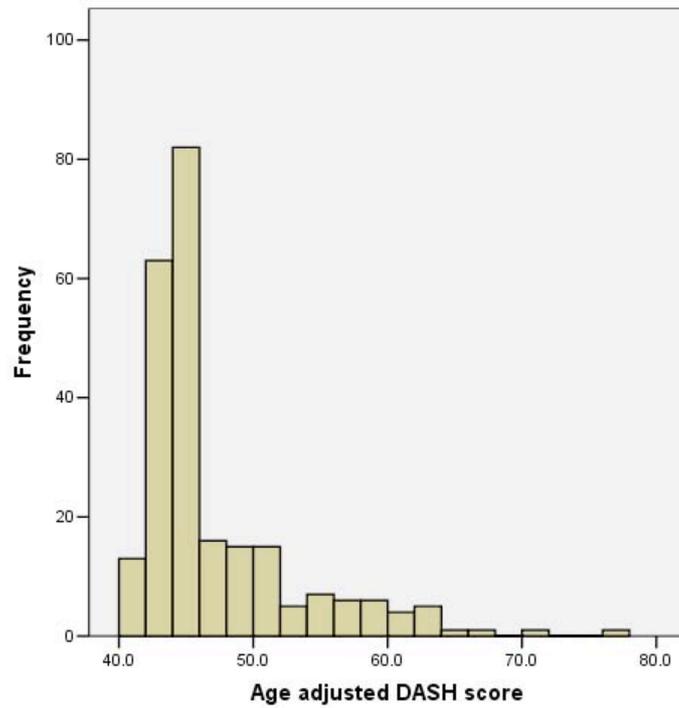
The average age of those reporting their age (n=241) was 41.4 years (SD 11.6 years) and ages ranged between 16 and 64 years. It was not possible to investigate the relationship between gender and disability because there were only 5 females in the population, however we were able to look at the effect of age. Figure 3.1 shows the relationship between disability score and age in the working population. Although there was considerable scatter there was a statistically significant correlation between the two variables ($p < 0.0001$, $r = 0.296$).

Figure 3.1 Relationship between disability score and age in the study population



For further analysis the DASH score was adjusted to an age of 45 years [16], so that the age relationship could be taken into account. The age-adjusted disability (DASH) scores did not follow a normal distribution (Figure 3.2) and had a median value of 44.8 with a range of 40.5 to 77.2. The inter-quartile ranges were 43.7 (25%), 44.8 (50%), and 49.2 (75%).

Figure 3.2 Distribution of age-adjusted DASH score in the study population



3.4 RELATIONSHIP BETWEEN DURATION OF VIBRATION EXPOSURE AND DISABILITY SCORE

The total number of years of exposure was significantly correlated with the age-adjusted disability score ($p=0.009$)(Figure 3.3), however the correlation between the disability score and \log_{10} (total lifetime hours of tool use/100) did not quite reach statistical significance ($p=0.062$) (Figure 3.4). The correlation coefficients for both of these relationships were poor (0.173 and 0.122 respectively)

Figure 3.3 Relationship between age-adjusted disability score and total number of years of vibration exposure

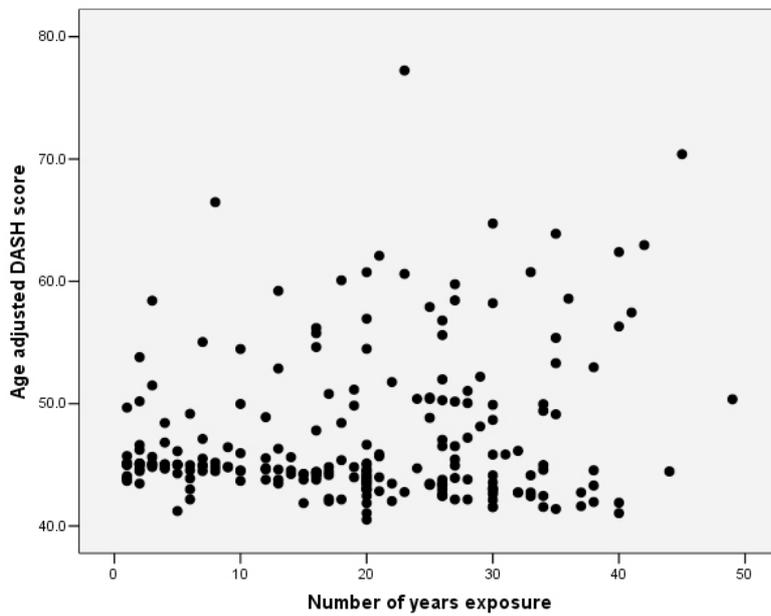
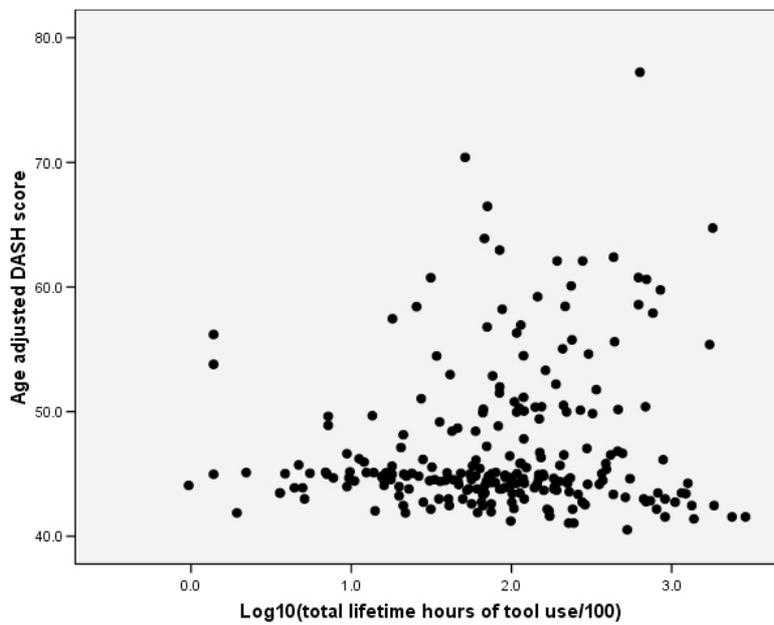


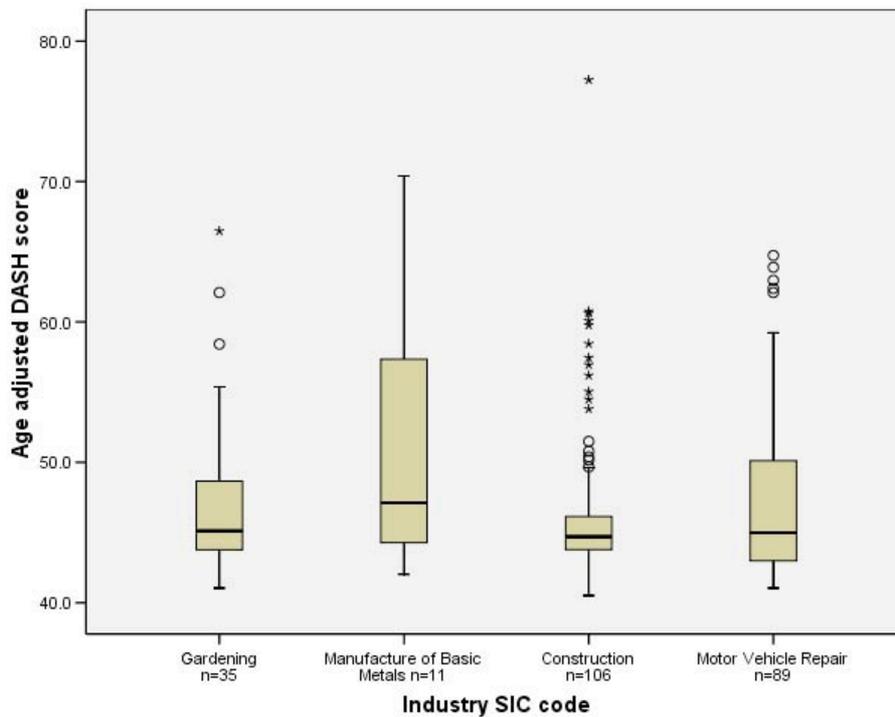
Figure 3.4 Relationship between age-adjusted disability score and total lifetime hours of tool use



3.5 DISABILITY SCORES IN THE FOUR DIFFERENT INDUSTRIES

Box and whisker plots of the age-adjusted disability scores in the four selected industries are shown in Figure 3.5. Unfortunately the number of responses in two of the groups was quite small (gardening n=35 and manufacture of basic metals n=11). When the median age-adjusted disability scores in the four industries were compared there were no statistically significant differences between industries (p=0.412).

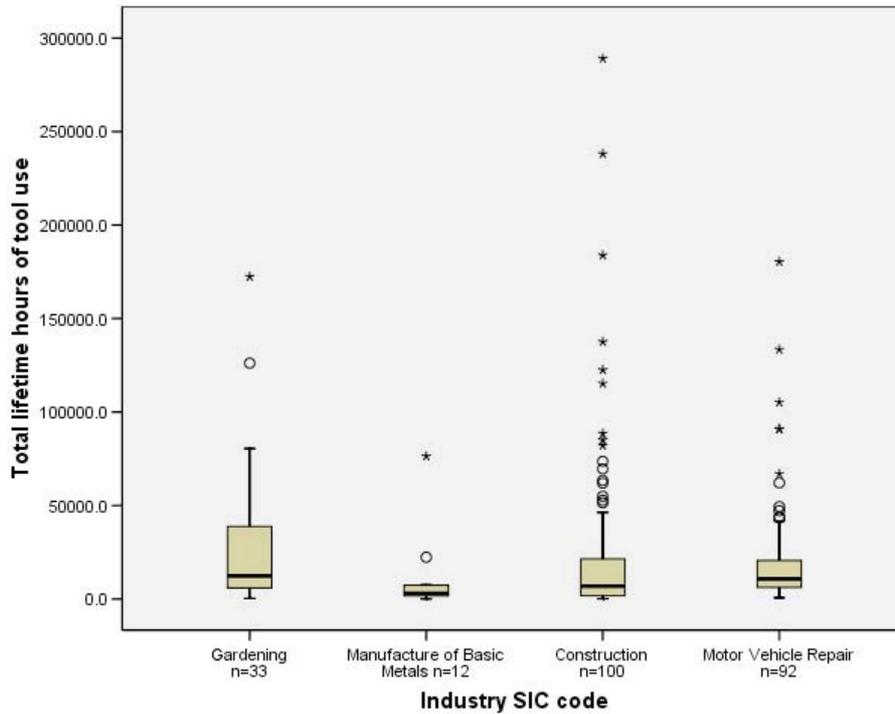
Figure 3.5 Age-adjusted disability score for those working in each industry



Box represents the values between which 75% and 25% of the data lie. Thick, dark horizontal line represents the median value. Whiskers represent the largest and smallest values that are not outliers. Open circles show the outliers that are defined as between 1.5 and 3 box lengths from the upper edge of the box. Asterisk represents extreme values.

However, there were some differences in duration of vibration exposure between the four industries. In terms of the total lifetime hours of tool use (Figure 3.6) the median level in those from the Motor vehicle repair industry was significantly higher than both the Manufacture of basic metals industry (p=0.003) and the construction industry (p=0.029). The only other statistically significant difference was that the Gardening industry had a higher median number of hours when compared to the Manufacture of basic metals (p=0.017).

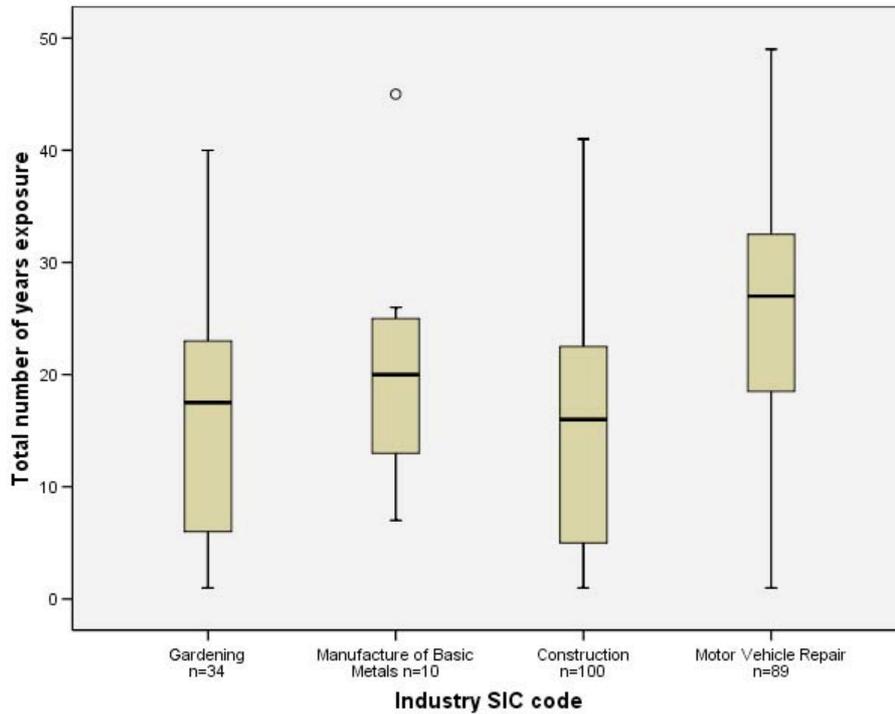
Figure 3.6 Total lifetime hours of tool use for each industry



Statistical comparisons of median values using Mann-U-Whitney test. All p-values are unadjusted for multiple comparisons. Agriculture vs Manufacture of Basic Metals ($p=0.017$), Agriculture vs construction ($p=0.070$), Agriculture vs Motor Vehicle Repair ($p=0.388$), Manufacture of Basic Metals vs Construction ($p=0.146$), Manufacture of Basic Metals vs Motor Vehicle Repair ($p=0.003$), Construction vs Motor Vehicle Repair ($p=0.029$).

The median total number of years of vibration exposure was significantly greater for the Motor vehicle repair industry compared to the three other industries (Figure 3.7). Some of these differences in exposure may be accounted for by differences in age between the industries. The mean (SD) age for the Gardening, Manufacture of Basic Metals, Construction and Motor Vehicle Repair industries were 42.0 (10.3), 45.9 (14.9), 36.9 (11.2) and 46.1 (10.2) years respectively. The only statistically significant differences between these were between the Construction and Motor Vehicle Repair industries ($p<0.001$).

Figure 3.7 Total number of years of vibration exposure in the four industries

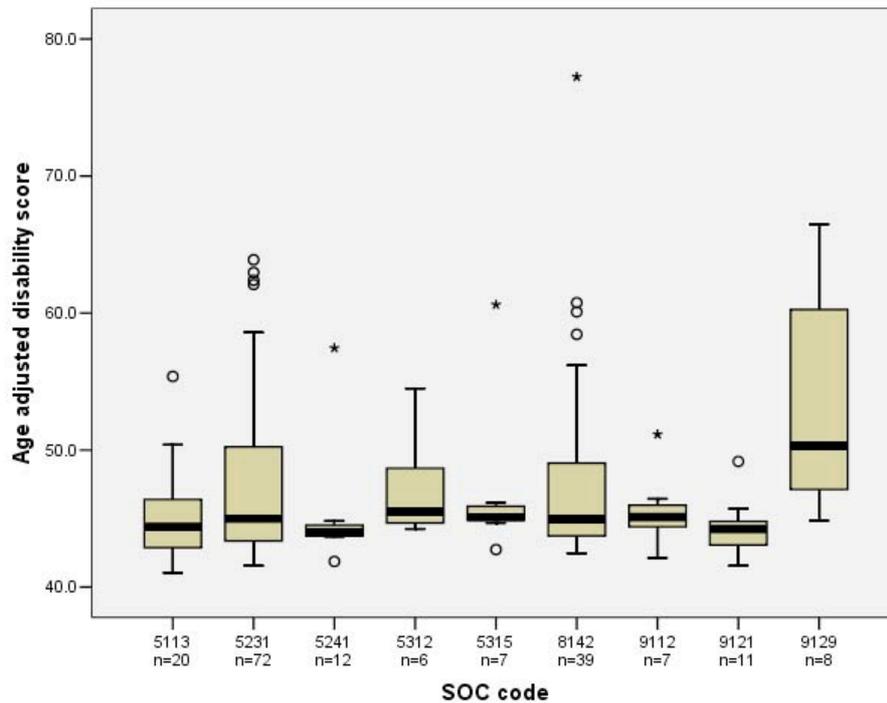


Statistical comparisons of median values using Mann-U-Whitney test. All p-values are unadjusted for multiple comparisons. Agriculture vs Manufacture of Basic Metals ($p=0.368$), Agriculture vs construction ($p=0.686$), Agriculture vs Motor Vehicle Repair ($p<0.0001$), Manufacture of Basic Metals vs Construction ($p=0.269$), Manufacture of Basic Metals vs Motor Vehicle Repair ($p=0.046$), Construction vs Motor Vehicle Repair ($p<0.0001$).

3.6 DISABILITY SCORES IN DIFFERENT TRADES

In the four selected industries there were 9 trades that had more than 5 individuals in them. The median age-adjusted disability scores were compared for these trades (Figure 3.8). The median disability score in the labourers from other construction trades (SOC 9129) was significantly greater than in all the other trades apart from bricklayers and masons (SOC 5312, $p=0.081$) and carpenters and joiners (SOC 5315, $p=0.054$). Electricians and electrical fitters (SOC 5241) had significantly lower median disability scores when compared to bricklayers and masons (SOC 5312, $p=0.024$) and carpenters and joiners (SOC 5315, $p=0.036$). The only other statistically significant difference was between bricklayers and masons (SOC 5312) and labourers in building and woodworking trades (SOC 9121, $p=0.048$).

Figure 3.8 Age adjusted disability score and trade



Trades compared were Gardeners and Groundsmen (5113), Motor mechanics and auto engineers (5231), Electricians and electrical fitters (5241), Bricklayers and masons (5312), Carpenters and joiners (5315), Road construction operatives (8142), Forestry workers (9112), Labourers in building and woodworking trades (9121) and Labourers in other construction trades (9129).

The distribution of DASH scores in some of the trades (5231, 8142 and 9129) appeared to have quite long tails towards more abnormal DASH scores. We investigated whether certain trades were associated with the more abnormal DASH scores. The trades of the individuals with the worst DASH scores (above 90th centile) were compared with those of the individuals in the remaining 90% of the population (Table 3.1).

Table 3.1 Proportion (%) of individuals from each trade in those with DASH scores over the 90th centile of the population and those below the 90th centile

Trade	Below 90 th centile (n=192)	Above 90 th centile (cut-off 56.29) (n=20)
Moulders, core makers, die casters (5212)	1.6 (3)	5.0 (1)
Motor mechanics and auto engineers (5231)	33.9 (65)	35.0 (7)
Electricians and electrical fitters (5241)	5.7 (11)	5.0 (1)
Carpenters and joiners (5315)	3.1 (6)	5.0 (1)
Plastic process operatives (8116)	0 (0)	5.0 (1)
Metal making and treating process operatives (8117)	0.5 (1)	10.0 (2)
Road construction operatives (8142)	18.2 (35)	20.0 (4)
Labourers in other construction trades (9129)	2.6 (5)	15.0 (3)

Values in table represent the % (n).

When the proportions of individuals in each trade were compared in the two groups (above and below 90th centile) there was no significant difference ($p=0.061$). There was a suggestion that certain trades (8116, 8117 and 9129) were more prevalent in the worst 10% of the population. However, the numbers in some of the groups are very small, making conclusions difficult.

The industries from which the worst 10% of the population came from were also investigated. There was a statistically significant ($p=0.025$) difference between the proportion of individuals from different industries in the two groups. The main difference was that there was a greater proportion of individuals from the Manufacture of Basic Metals industry in those above the 90th centile when compared to those below (16.7% compared to 3.2%)

3.7 DISABILITY SCORE AND USE OF VIBRATION PRODUCING TOOLS

The relationship between tool use and the disability score was investigated in two ways (i) by comparing the age-adjusted disability score in those that had or had not used a particular tool in their working life and (ii) by investigating the correlation between the age-adjusted disability score and the total lifetime hours of tool use. Both analyses are limited by the fact that they only take into account single tool use, not combinations of tool use. In order to take into account multiple tool use more sophisticated statistical techniques would need to be employed.

When the median age-adjusted disability scores for those that had or had not used a tool were compared there were no statistically significant differences, when adjusted for multiple comparisons (Table 3.2).

Table 3.2 Median age-adjusted disability scores (n) and use of a tool within working lifetime

Tool	No use of tool	Yes used tool	P value
Chipping hammers	44.7 (129)	45.0 (112)	0.310
Rock drills	44.8 (166)	44.8 (75)	0.387
Large angle grinders	44.9 (118)	44.7 (123)	0.412
Small angle grinders	44.8 (101)	44.9 (140)	0.862
Road breakers	44.8 (144)	44.8 (97)	0.957
Disc cutter	45.0 (132)	44.7 (109)	0.272
Compaction plates	44.9 (154)	44.8 (87)	0.512
Rollers	44.8 (180)	45.1 (61)	0.405
Vibrating poker	44.8 (193)	45.0 (48)	0.460
Scabblers	44.8 (214)	44.2 (27)	0.213
Rammers	45.0 (212)	44.2 (29)	0.470
Needle scaler	44.9 (204)	44.6 (37)	0.409
Sanders	44.8 (181)	45.0 (60)	0.848
Die grinders	44.8 (207)	44.8 (33)	0.715
Saws	44.9 (179)	44.7 (62)	0.130
Planer	44.8 (202)	44.7 (39)	0.327
Impact drills	44.8 (125)	44.9 (116)	0.817
Wrenches	44.8 (141)	44.9 (100)	0.751
Rivetting hammers	44.8 (205)	45.1 (36)	0.819
Nail guns	44.8 (182)	45.0 (59)	0.888
Nibblers	44.9 (198)	44.6 (43)	0.378
Floor polishers	44.9 (218)	44.2 (23)	0.207
Brush cutters	45.0 (170)	44.5 (71)	0.064
Chainsaws	44.9 (193)	44.5 (48)	0.161
Hedgecutters	44.9 (175)	44.6 (66)	0.036
Mowers	45.0 (160)	44.3 (81)	0.004

Scarifiers	44.8 (207)	44.7 (34)	0.377
Rotavators	44.9 (209)	44.4 (32)	0.034
Blowers	44.8 (203)	44.6 (38)	0.187
High pressure hoses	44.9 (158)	44.6 (83)	0.214
Pedestal grinders	44.9 (167)	44.8 (74)	0.703
Bench saws	44.9 (212)	44.6 (29)	0.168
Finishers	44.8 (221)	44.4 (20)	0.132
Floor nibblers	44.9 (229)	43.6 (12)	0.023

p-value needed for statistical significance at 5% level was 0.001, as this was adjusted for the number of multiple comparisons.

In addition to simply investigating whether a tool had been used or not we also investigated whether there was a correlation between the total lifetime hours of tool use and disability score (Table 3.3). There were no statistically significant correlations when adjusted for multiple comparisons.

Table 3.3 Correlation between the age-adjusted disability score and the total lifetime hours of tool use

Tool	Pearson correlation	P-value
Chipping hammers	0.084	0.200
Rock drills	-0.068	0.299
Large angle grinders	0.029	0.661
Small angle grinders	0.062	0.344
Road breakers	0.066	0.317
Disc cutter	0.018	0.779
Compaction plates	-0.035	0.591
Rollers	0.076	0.244
Vibrating poker	-0.052	0.423
Scabblers	-0.146	0.025
Rammers	0.021	0.751
Needle scaler	-0.090	0.163

Sanders	-0.004	0.956
Die grinders	0.057	0.382
Saws	-0.076	0.244
Planer	-0.046	0.479
Impact drills	0.021	0.749
Wrenches	0.020	0.753
Rivetting hammers	-0.026	0.693
Nail guns	-0.063	0.333
Nibblers	-0.002	0.971
Floor polishers	-0.024	0.718
Brush cutters	-0.047	0.467
Chainsaws	-0.114	0.080
Hedgecutters	-0.129	0.048
Mowers	-0.058	0.370
Scarifiers	0.006	0.932
Rotavators	-0.123	0.058
Blowers	-0.075	0.248
High pressure hoses	-0.122	0.059
Pedestal grinders	-0.004	0.948
Bench saws	-0.068	0.291
Linishers	-0.110	0.088
Floor nibblers	-0.101	0.120

p-value needed for statistical significance at 5% level was 0.001, as this was adjusted for the number of multiple comparisons.

3.8 DISABILITY SCORE AND HEALTH PROBLEMS OR SYMPTOMS

3.8.1 Self-reported health problems and symptoms

Overall, 7.4% (n=18) of the group reported that they had been diagnosed with VWF or HAVS (question 10 on questionnaire) and a further 19.3% (n=47) of the group reported that they did have another health problem that they thought was important (question 53 on questionnaire). These other self-reported health problems were categorised as upper limb, back/lower limb or other (Table 3.4). In general, 12.7% reported some upper limb problem (i.e. upper limb or HAVS) and 11.1% reported a back/lower limb problem.

We also investigated the prevalence of self-reported symptoms in the population. Around a third of the group (32.2%) reported that they had pain or problems with their hands/wrists (question 52), and this seemed to be related to the industry the individuals worked in ($p=0.001$). In fact, whilst the gardening, manufacture of basic metals and motor vehicle repair industries seem to have a similar proportion of individuals reporting symptoms (42.2-45.5%), the construction industry demonstrated a much lower percentage with pain or problems (18.9%). This pattern was also seen for reported pain in the neck, shoulder and arms (questions 49, 50 and 51).

Around a quarter of the group (24.1%) reported that they woke at night with pain, tingling/numbness in the hands (question 18) and this was greatest in the Motor Vehicle Repair industry (33.3%) and lowest in the construction industry (16.2%) ($p=0.048$). The proportion of individuals reporting that their fingers went white in the cold was 20.2% and this was highest in the gardening industry (31.4%), although not statistically significant ($p=0.409$). There was a significant effect of industry on the proportion of individuals reporting tingling after using tools ($p=0.038$), with the greatest proportion being in the manufacture of basic metals industry (27.3%) and the lowest in the construction industry (12.5%).

Table 3.4 Proportion of group who have self-reported health problems or symptoms in the upper extremity

Self-reported health problems (% reporting problem) (questions 10 and 53)	Whole group	Gardening	Man of basic metals	Construction	Motor vehicle repair	p
Upper Limb	5.3	5.7	9.1	2.8	7.7	-
HAVS	7.4	14.3	18.2	5.7	5.5	-
Back/lower limb	11.1	14.3	18.2	7.5	13.2	-
Other	2.9	5.7	0	0.9	4.4	-
Self-reported symptoms (% giving 'yes' response)						
Have your fingers gone white on exposure to cold? (question 11)	20.2	31.4	9.1	16.0	22.0	0.409
Do your fingers tingle for more than 20 minutes after using vibrating equipment? (question 14)	15.5	17.1	27.3	12.5	16.9	0.038
Do your fingers go numb for more than 20 minutes after using vibrating equipment? (question 16)	12.0	17.1	27.3	12.3	7.8	0.253
Do you ever wake from sleep with any pain, tingling or numbness in your hands/wrists or arms? (question 18)	24.1	22.9	27.3	16.2	33.3	0.048
In general, have you pain or problems with your neck? (question 49)	27.7	42.9	45.5	16.2	33.0	0.003
In general, have you pain or problems with your shoulder? (question 50)	28.4	40.0	45.5	17.9	34.1	0.011
In general, have you pain or problems with your arms? (question 51)	26.6	22.9	36.4	19.0	35.6	0.056
In general, have you pain or problems with your hands/wrists? (question 52)	32.2	42.9	45.5	18.9	42.2	0.001

p-values are from Chi-squared analysis.

The proportion of individuals reporting symptoms was also related to whether they self-reported a health problem and the nature of that problem (Table 3.5). In general, a greater proportion of those individuals who had been diagnosed with HAVS experienced symptoms or pain when compared to those with other health problems, or no health problems at all (Table 3.5). Those

with upper limb problems had a greater proportion of individuals with pain in their arms or hands/wrists when compared to the group as a whole, or with those without a reported health problem. In general, the groups reporting health problems had a higher mean age when compared to those who did not report problems, however this only reached statistical significance with the group reporting back/lower limb problems ($p=0.031$).

Table 3.5 Proportion of individuals with self-reported health problems who also report symptoms in the upper extremity

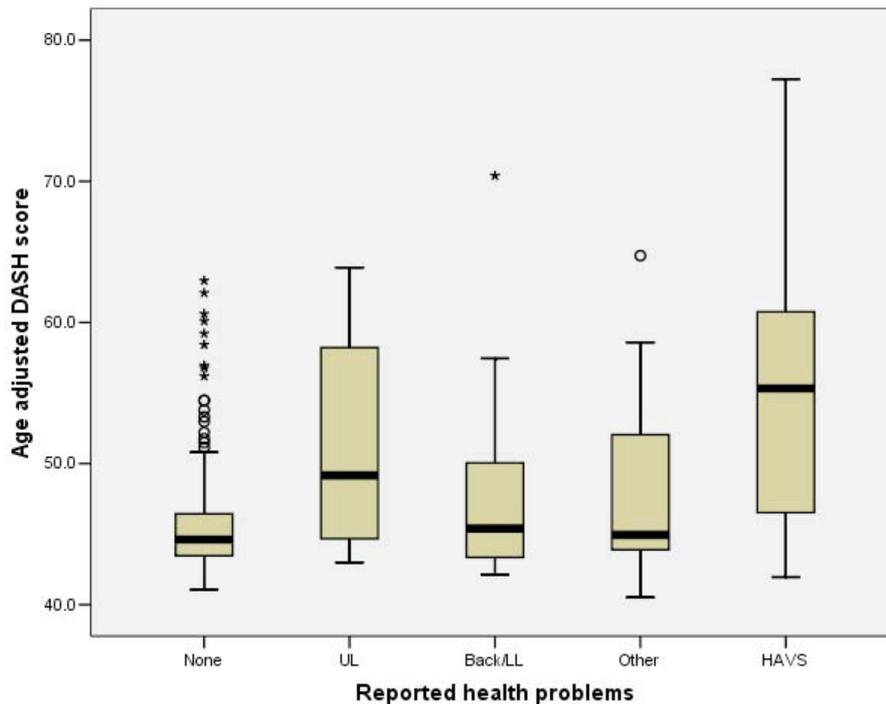
Self-reported symptoms (% giving 'yes' response)	Whole group	HAVS	Upper limb	Back/lower limb	Other	None	p
Have your fingers gone white on exposure to cold? (question 10)	20.2	83.3	23.1	33.3	42.9	10.7	<0.001
Do your fingers tingle for more than 20 minutes after using vibrating equipment? (question 14)	15.5	66.7	30.8	15.4	28.6	8.6	<0.001
Do your fingers go numb for more than 20 minutes after using vibrating equipment? (question 16)	12.0	66.7	15.4	19.2	28.6	4.5	<0.001
Do you ever wake from sleep with any pain, tingling or numbness in your hands/wrists or arms? (question 18)	24.1	50.0	38.5	26.9	42.9	19.2	0.018
In general, have you pain or problems with your neck? (question 49)	27.7	50.0	30.8	42.3	28.6	23.0	0.055
In general, have you pain or problems with your shoulder? (question 50)	28.4	50.0	30.8	33.3	28.6	25.3	0.254
In general, have you pain or problems with your arms? (question 51)	26.6	44.4	53.8	33.3	42.9	21.0	0.015
In general, have you pain or problems with your hands/wrists? (question 52)	32.2	77.8	75.0	44.4	57.1	21.9	<0.001
Mean age (years)	41.4	44.4	43.9	47.1*	45.9	39.9*	0.017

*mean ages significantly different from each other ($p=0.031$). P-values are from Chi-squared analysis.

3.8.2 Relationship between self-reported health problems or symptoms and disability score

The influence of reported health problems on the disability score was investigated (Figure 3.9). Both the reporting of upper limb problems and HAVS gave significantly elevated disability scores when compared to those who did not report problems ($p=0.007$ and $p<0.0001$ respectively). There was no significant difference between the median levels for those with upper limb problems or HAVS ($p=0.211$).

Figure 3.9 Influence of self-reported health problems on the age-adjusted DASH score



None relates to no reported health problems ($n=177$), UL relates to upper limb problem ($n=13$), Back/LL relates to back or lower limb problem ($n=26$), HAVS relates to diagnosed with HAVS/VWF ($n=18$) and Other relates to any other problem reported ($n=7$).

Statistical comparisons of median values using Mann-U-Whitney test. All p-values are unadjusted for multiple comparisons. No problems vs UL ($p=0.007$), no problems vs back/LL ($p=0.339$), no problems vs HAVS ($p<0.0001$), UL vs back/LL ($p=0.081$), UL vs HAVS ($p=0.211$), back/LL vs HAVS ($p=0.003$).

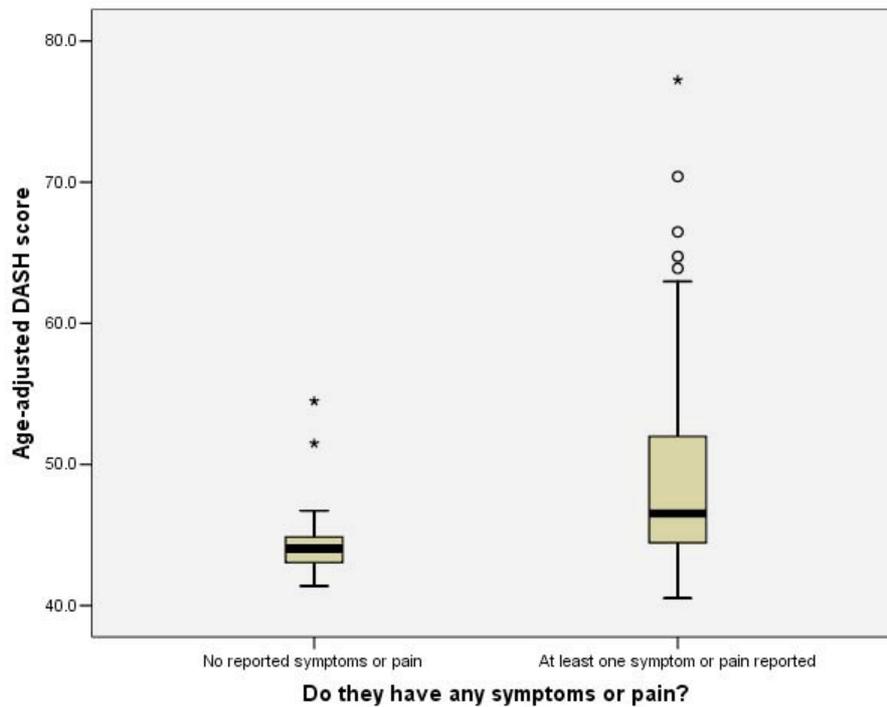
Figure 3.9 shows that in those individuals who did not report any health problems (None group) a number of individuals had disability scores that were seen as outliers from the distribution in the group. It is possible that some of these individuals had symptoms or pain consistent with upper limb problems or HAVS, which were not diagnosed but may have affected their functionality. In the group that did not report any health problems we looked at whether those answering 'yes' to certain questions known to be related to HAVS, carpal tunnel syndrome or pain in the neck and upper limbs had higher disability scores (Table 3.6). For all of these selected questions related to symptoms the group responding 'yes' had a significantly higher median disability score when compared to those who responded negatively (Table 3.6).

Table 3.6 Median disability scores and responses to questions relating to symptoms in those workers who did not report health problems (None group)

Question	Median DASH score in those answering 'no'	n	Median DASH score in those answering 'yes'	n	P value
Have your fingers gone white on exposure to cold? (question 11)	44.6	155	47.1	19	0.006
Do your fingers tingle for more than 20 minutes after using vibrating equipment? (question 14)	44.6	121	50.0	15	0.001
Do your fingers go numb for more than 20 minutes after using vibrating equipment? (question 16)	44.6	145	54.9	8	0.003
Do you ever wake from sleep with any pain, tingling, or numbness in your hands/wrists or arms? (question 18)	44.6	143	45.9	33	0.032
Have you pain or problems with your neck? (question 49)	44.4	137	47.8	40	<0.0001
Have you pain or problems with your shoulders? (question 50)	44.2	133	48.1	44	<0.0001
Have you pain or problems with your arms? (question 51)	44.2	138	48.9	37	<0.0001
Have you pain or problems with your hands/wrists? (question 52)	44.4	138	48.9	39	<0.0001

Individuals who said 'yes' to experiencing pain in at least one location, or any of the selected symptoms were grouped together and compared to those who did not report any problems or symptoms. The median disability score in the symptomatic group was significantly higher than in those who did not report symptoms ($p=0.0001$) (Figure 3.10).

Figure 3.10 Distribution of age-adjusted disability scores in those with or without symptoms or pain



3.8.3 Which symptom questions are the most important predictors of disability score?

Although answering 'yes' to any of the symptom questions appeared to be related to an elevated DASH score, this does not tell us which of these questions is most related to the DASH score and account for correlations between the questions. To do this we performed stepwise multiple linear regression on all of the data, and then with those known to have a self-reported health problem (e.g. HAVS) excluded (i.e. the None group).

Table 3.7 shows the results of the analysis where all data are included. Overall, four questions were found to be predictive of the DASH score. The three largest predictors were related to pain/problems in the hands/wrists, arms and shoulders respectively. Tingling of the fingers following use of vibrating tools was also associated with a raised DASH score. The overall adjusted R squared value for this model was 0.697.

Table 3.7 Linear regression model relating symptom questions to DASH score using all data available

Question		Mean DASH score	P value	Partial Eta Sq
Have you pain or problems with your hands/wrists?	Extreme	61.6	<0.001	0.343
	Quite a bit	62.4		
	Moderately	57.4		
	Slightly	52.9		
	Not at all	52.1		
Have you pain or problems with your arms?	Extreme	59.9	<0.001	0.136
	Quite a bit	58.1		
	Moderately	60.1		
	Slightly	55.0		
	Not at all	53.4		
Have you pain or problems with your shoulders?	Extreme	62.5	0.001	0.080
	Quite a bit	56.6		
	Moderately	57.2		
	Slightly	56.0		
	Not at all	54.2		
Do your fingers tingle for more than 20 minutes after using vibrating equipment?	Yes	58.4	0.001	0.045
	No	56.2		

When those who had reported a specific health problem were excluded (i.e. the None group) the same questions were maintained in the model, although the order was slightly different (Table 3.8). One additional question was added to the model 'Do you ever wake from sleep with any pain, tingling, or numbness in your hands/wrists or arms?'. The overall adjusted R squared value for the model was 0.633.

Table 3.8 Linear regression model relating symptom questions to DASH score (excluding those with self-reported health problems)

Question		Mean DASH score	P value	Partial Eta Sq
Have you pain or problems with your hands/wrists?	Extreme	-	<0.001	0.258
	Quite a bit	55.8		
	Moderately	57.4		
	Slightly	50.4		
	Not at all	49.5		
Have you pain or problems with your arms?	Extreme	-	<0.001	0.229
	Quite a bit	51.8		
	Moderately	58.1		
	Slightly	52.1		
	Not at all	51.1		
Do your fingers tingle for more than 20 minutes after using vibrating equipment?	Yes	55.0	<0.001	0.135
	No	51.6		
Have you pain or problems with your shoulders?	Extreme	-	0.001	0.104
	Quite a bit	55.9		
	Moderately	53.2		
	Slightly	52.8		
	Not at all	51.2		
Do you ever wake from sleep with any pain, tingling, or numbness in your hands/wrists or arms?	Yes	52.6	0.007	0.044
	No	54.0		

4 DISCUSSION AND CONCLUSION

This study has collected information regarding self-reported disability and symptoms in working cohorts exposed to hand-arm vibration and known to be associated with a high risk of HAVS. The information was collected, in part, using the DASH questionnaire with a single quantitative outcome score. This internationally used questionnaire is generic for both functional problems and symptoms in the upper limbs [3, 19], and should reflect such problems whether caused by hand-transmitted vibration (HAVS) or upper limb musculo-skeletal disorders associated with industries where vibrating tools are used. This score can be used comparatively across populations or prospectively within populations to look at the effects of various interventions. It also has general population normative data available for comparison. We have already shown in HAVS referral subjects that the DASH score is associated with the Stockholm workshop scale, particularly the neurosensory score [14]. However, it has not been applied in a workplace setting with hand transmitted vibration exposure. In this workplace study, where vibration-induced damage (HAVS), and both upper limb and other musculoskeletal problems may occur, we investigated both of these influences on the DASH outcome score.

We aimed to obtain a population of individuals currently working with vibrating tools, and consequently used intermediaries (health and safety managers, occupational health professionals, union representatives) to distribute questionnaires within the target companies and industries. Volunteers were not given any form of inducement for completing the questionnaire. This method of recruitment led to a low response rate (14%) and we were not able to obtain any information on the individuals who did not respond. Therefore, we are not able to say whether the individuals who did not respond were more likely to have problems leading to a 'healthy-worker' effect. This low response rate is a significant limitation of this study and means that the results should be used with caution, especially in making inferences regarding the working population as a whole. It is also important to realise that we focussed on four specific industries: Gardening, Manufacture of Basic Metals, Construction and Motor Vehicle Repair in this study. The industries selected for involvement in this study were determined following discussions with key parties in HSE. The Manufacture of Basic Metals industry was chosen because it is well established that this industry has a high prevalence of HAVS and consequently given our previous work on the relationship between HAVS and disability [14, 15], would be likely to have significant disability. The Gardening industry was chosen because this industry appears to experience significant levels of HAVS according to our own data from the HSL referral centre (unpublished). The Motor Vehicle Repair industry was chosen because there had been reports of HAVS following short daily exposure to hand-arm vibration in car mechanics [20, 21]. However, we feel that even with these accepted limitations and potential biases this study has revealed some interesting findings that have not been reported elsewhere.

Overall there was a large range of disability scores within the study population, with a limited number showing relatively large (extreme) values, which would be seen as outliers from their distribution. As would be expected, age was an important determinant of the DASH score, with older individuals having greater disability. Therefore, to take age into account in any analyses we adjusted all of our DASH scores to that we would expect of a 45 year-old man [16]. When the median DASH scores were compared across the four selected industries we did not find any significant differences between them, even though the duration of vibration exposure (in terms of total lifetime hours of tool use and total number of years of exposure) appeared to be significantly greater in the Motor Vehicle Repair industry. Overall, there was some relationship between the DASH score and extent of duration of vibration exposure, particularly the total years of exposure, but this was weak. There was no evidence that the use of any particular hand-held vibrating tool was associated with elevated disability scores. However, this lack of

association between the DASH score and duration of vibration exposure in the study population maybe explained by (i) only 7.4% of the study population reported being diagnosed with HAVS and (ii) we were unable to take account of multiple tool use in the statistical analysis. This apparent lack of relationship between disability and vibration exposure may not be the case if a study population with a greater prevalence of HAVS were studied.

There was some evidence of some differences in median DASH scores between trades, with labourers in other construction trades (SOC 9129) having the greatest value, but full comparison between trades is restricted because of small numbers in some trades. In addition, to looking at the central tendency we also investigated if any particular trades or industries had a tendency to more extreme values and more disability. To do this we looked at the individuals in the worst 10% of the study population to see if they came from particular industries or trades. When we compared the trades the numbers in each group were a little too small to draw any conclusions from, but as may be expected there was a greater proportion from the Manufacture of Basic Metals Industry.

The DASH questionnaire is an instrument that assesses disability in the whole of the upper limb and therefore its output may be affected by a whole range of upper limb problems (e.g. HAVS, Carpal Tunnel Syndrome, arthritis, Dupuytren's contracture etc.). Upper limb problems have been noted in populations using vibrating tools, but there has been little investigation of the influence of such co-morbidities on the disability in those with HAVS. We wished to investigate whether the range of DASH values measured within this study population was related to any pre-existing health problem the individuals were experiencing. These pre-existing self-reported health problems were divided into upper limb problems (e.g. Carpal Tunnel Syndrome, arthritis in upper limb, tennis elbow etc.), back or lower limb problems, HAVS and other. Overall, in this working population 7.4% reported being diagnosed with HAVS, 5.3% had an upper limb problem, 11.1% had a back or lower limb problem and 2.9% had some other problem not affecting the upper limbs. The outcome on the DASH questionnaire was responsive to both upper limb disorders and HAVS, with both of these reported health problems having median DASH values significantly different to those who did not report any health problems. These data support the fact that the DASH questionnaire is specifically responsive to disorders of the upper limbs and supports its usefulness in these disorders.

When we looked at the distribution of DASH values in individuals who did not report any health problems it was variable, with a number of individuals having outlying values from the distribution. It was reasoned that perhaps these outlying values were related to some other symptom in the upper limb leading to increased disability, which was pre-diagnostic. We found that a large proportion of individuals within the study population reported experiencing symptoms of pain in some component of the upper limbs (27.7% neck, 28.4% shoulder, 26.6% arms and 32.2% hands/wrists) and that these proportions were still high even in those not reporting any health problems (23.0%, 25.3%, 21.0% and 21.9% respectively). These proportions are similar to those reported in a general population study where Palmer *et al* found that in those exposed to hand-arm vibration 22.7% reported pain in the neck, 26.3% had pain in the shoulders and 21.9% had pain in the hands/wrists [22]. Therefore, both the present study and that of Palmer *et al* show that significant levels of upper limb musculo-skeletal disorders are present in workers using vibrating tools. In addition, the study of Palmer *et al* also reported significant proportions that reported these symptoms and were not exposed to vibration (16%, 16.7% and 9.7% respectively).

The prevalence of blanching in cold conditions in the group as a whole was 20.2%, and reduced to 10.7% when those with self-reported health problems were excluded. Interestingly, only 7.4% of the group had been diagnosed as having HAVS and this is not surprising considering it

has been reported that around one fifth of individuals with blanching in the general population consult a doctor about these symptoms [23]. The proportions of individuals experiencing these symptoms in the current study are a little higher than those reported from the MRC general population study where 5.5% of men who were exposed to vibration at work reported blanching, compared to 2.4% who were not exposed to vibration [24]. We have also found that the overall proportion of individuals reporting waking from sleep with pain in hands/wrists in the present study (24.1%) is higher than that reported in the MRC general population study (9.3% in those vibration exposed) [25]. The reason why the proportions reporting blanching or waking from sleep are greater in the current study are unclear but may be related to differences in terminology of the questions, or perhaps related to the fact that we focussed on particular industries that we thought were likely to have health problems related to vibration exposure. It should also be borne in mind that health surveillance is now a legal requirement for vibration-exposed workers [26] and this was not the case when the MRC general population study was conducted. It is possible that the differences in reported symptoms between our study population and the MRC general population may be a consequence of raised awareness through health surveillance, particularly in high risk industries.

Experiencing any of the symptoms related to pain, tingling/numbness or blanching (even if they did not have a self-reported health problem) was associated with an increased disability score. However, when we investigated which of the questions had the greatest impact the questions related to blanching or numbness did not seem to be important. The questions related to pain or problems in specific areas of the upper limb had the most impact on the DASH score. The most important predictor in all of the study population was pain/problems in the hands/wrists followed by pain/problems with the arms, pain/problems with the shoulders and tingling after using vibrating tools. If individuals with self-reported health problems were excluded one additional question appeared in the model (Do you ever wake from sleep with any pain, tingling or numbness in your hands/wrists or arms?), however this appeared to be associated with a reduction in DASH score and is likely to be a statistical anomaly. These questions related to pain may be a useful adjunct to normal HAVS screening questions to help identify workers with upper limb disorders, where a full DASH questionnaire is not going to be used.

The findings related to symptoms are interesting and would suggest that the DASH questionnaire is responsive to problems in the upper limbs, even in individuals who do not report having any health problems. It is possible that individuals have failed to report problems that might explain these symptoms, or it maybe that these symptoms represent changes in the upper limbs that have not yet been troublesome enough for individuals to report to health professionals and seek diagnosis. It is conceivable that the DASH questionnaire is a sensitive method of detecting changes in the upper limb that may eventually be diagnosed as an upper limb problem.

In conclusion, this study has shown that when the DASH questionnaire is applied to a population working with hand-held vibrating tools that useful information regarding disability in the upper limbs can be obtained. In the study population the disability outcome measure is related to reported health problems in the upper limbs and self-reported symptoms, particularly pain. This study suggests that the DASH questionnaire may be a useful tool for integrating, on a quantitative basis, the health problems caused by HAVS and upper limb co-morbidities that are found in significant levels in workforces using vibrating tools.

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6 APPENDICES

6.1 APPENDIX ONE - QUESTIONNAIRE

Dear Recipient - Thank you for taking the time to complete this questionnaire. Where you have a choice of answers please complete by putting a CROSS in the box most relevant to you e.g. X

GENERAL INFORMATION

1. Today's date / /
 2. What is your age?
 3. Are you? Male Female

EMPLOYMENT AND VIBRATION HISTORY

4. What is your current employment status? Employed Self-employed Unemployed Retired Long-term sick

5. Have you used hand held vibrating tools/hand guided/hand fed vibrating machines in your:
 current job past job never used
If you have answered that you have NEVER USED vibrating tools in your work please go to question 8.

6. In what year did you first start using vibrating tools in your work?
 7. How many years in total have you used vibrating tools in your work?
If you are not sure exactly how many years please give an estimate

8. Job History

From (Year)	To (Year)	Trade/Job
YYYY	YYYY	

Please fill in the box above giving your trade or job (For example, carpenter, fletcher, driver, fitter) and the date you started and finished it. If you have changed trades, please give the same details for each trade you have followed. Please fill this in even if you have not used vibrating tools.

9. What INDUSTRY do you carry out your current job in?
For example construction, motor vehicle repair, foundry, landscape gardening etc.

MEDICAL HISTORY

10. Have you ever been diagnosed as having hand-arm vibration syndrome (HAVS) or vibration white finger (VWF)? Yes No
 15. Do your fingers tingle in the cold? Yes No

11. Have your fingers gone white* on exposure to cold? Yes No
 *white means a clear difference in colour of the fingers with a sharp edge, usually followed by a red flush.
 16. Do your fingers go numb for more than 20 minutes after using vibrating equipment? Yes No Not applicable

12. If yes to question 11 what year did you first notice this?
 17. Do your fingers go numb in the cold? Yes No

13. Do your fingers go numb when they go white? Yes No Not applicable
 18. Do you ever wake from sleep with any pain, tingling, or numbness in your hands/wrist or arms? Yes No

14. Do your fingers tingle for more than 20 minutes after using vibrating equipment? Yes No Not applicable

MVR

DIFFICULTIES IN PERFORMING EVERYDAY ACTIVITIES

This section asks you about any symptoms, as well as your ability to do certain everyday jobs or tasks. Please answer each question, based on your condition in the LAST WEEK by putting a CROSS in the appropriate box.

Even if you did not carry out any of the specific tasks in the last week, please put a cross in the box which you think would accurately reflect your ability to carry out the task.

It does not matter which hand or arm you use to carry out the tasks listed; please answer based on your ability regardless of how you carry out the task.

Please rate your ability to do the following activities in the last week by putting a CROSS in the appropriate box.

19. Open a tight or new jar	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
20. Write	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
21. Turn a key	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
22. Prepare a meal	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
23. Push open a heavy door	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
24. Place an object on a shelf above your head	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
25. Do heavy household chores (e.g wash walls, wash floors)	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
26. Garden or do yard work	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
27. Make a bed	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
28. Carry a shopping bag or briefcase	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
29. Carry a heavy object (over 10 lbs)	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
30. Change a lightbulb overhead	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
31. Wash or blow dry your hair	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
32. Wash your back	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
33. Put on a pullover sweater	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
34. Use a knife to cut food	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
35. Recreational activities which require little effort (e.g. card playing, knitting, etc)	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable

36. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis, etc)	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
37. Recreational activities in which you move your arm freely (e.g. playing frisbee, badminton, etc.)	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
38. Manage transportation needs (getting from one place to another)	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
39. Sexual activities	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> Unable
40. During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Slightly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Extremely
41. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	<input type="checkbox"/> Not limited at all	<input type="checkbox"/> Slightly limited	<input type="checkbox"/> Moderately Limited	<input type="checkbox"/> Very Limited	<input type="checkbox"/> Unable
Please rate the severity of the following symptoms in the last week					
42. Arm, shoulder or hand pain	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
43. Arm, shoulder or hand pain when you performed any specific activity	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
44. Tingling (pins and needles) in your arm, shoulder or hand	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
45. Weakness in your arm, shoulder or hand	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
46. Stiffness in your arm, shoulder or hand	<input type="checkbox"/> None	<input type="checkbox"/> Mild	<input type="checkbox"/> Moderate	<input type="checkbox"/> Severe	<input type="checkbox"/> Extreme
47. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	<input type="checkbox"/> No difficulty	<input type="checkbox"/> Mild difficulty	<input type="checkbox"/> Moderate difficulty	<input type="checkbox"/> Severe difficulty	<input type="checkbox"/> So much difficulty that I can't sleep
48. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neither agree nor disagree	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
49. In general, have you pain or problems with your neck?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Slightly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Extreme
50. In general, have you pain or problems with your shoulders?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Slightly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Extreme
51. In general, have you pain or problems with your arms?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Slightly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Extreme
52. In general, have you pain or problems with your hands/wrists?	<input type="checkbox"/> Not at all	<input type="checkbox"/> Slightly	<input type="checkbox"/> Moderately	<input type="checkbox"/> Quite a bit	<input type="checkbox"/> Extreme
53. Do you have any other health problems that you think are important?	<input type="text"/>				

HISTORY OF TOOL USE

If you have answered that you have NEVER USED VIBRATING TOOLS in Question 5 there is no need to fill in the rest of this questionnaire. Thank you for your time.

If you HAVE USED VIBRATING TOOLS in your current or past jobs we would like you to fill in the rest of this questionnaire. We would like you to estimate the total time you have used particular vibrating tools. This should be the time you have actually been using the tool in your job and the tool has been on (trigger time). Please go through the following pages and for every tool you have used, put a CROSS in the box which includes your estimate of the average time per day you used the tool in your work. (We understand this may be a rough estimate based on many years of different work patterns.) Also put a CROSS in the box which includes the total number of years you have used that tool. If there is a tool that you have used and which is not identified, please give the same information in the 'other tools' box at the end of this section.

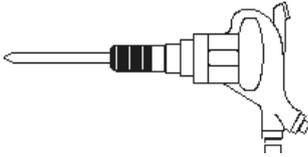
HAND-HELD TOOLS

*Average time per day
(this should be trigger time)*

*Total number of years tool
used*

CHIPPING HAMMERS AND STONEMWORKING TOOLS

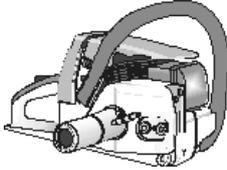
e.g Jigger picks, Air chisel, Zip gun, Chipping guns, Heading Hammers



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- | | |
|--|--|
| <input type="checkbox"/> Less than 2 years | <input type="checkbox"/> 16-20 years |
| <input type="checkbox"/> 2-5 years | <input type="checkbox"/> 21-30 years |
| <input type="checkbox"/> 6-10 years | <input type="checkbox"/> Greater than 30 years |
| <input type="checkbox"/> 11-15 years | |

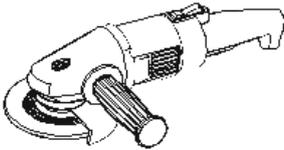
ROCK DRILLS AND ROTARY HAMMERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- | | |
|--|--|
| <input type="checkbox"/> Less than 2 years | <input type="checkbox"/> 16-20 years |
| <input type="checkbox"/> 2-5 years | <input type="checkbox"/> 21-30 years |
| <input type="checkbox"/> 6-10 years | <input type="checkbox"/> Greater than 30 years |
| <input type="checkbox"/> 11-15 years | |

LARGE ANGLE GRINDERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

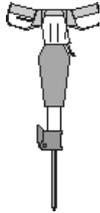
- | | |
|--|--|
| <input type="checkbox"/> Less than 2 years | <input type="checkbox"/> 16-20 years |
| <input type="checkbox"/> 2-5 years | <input type="checkbox"/> 21-30 years |
| <input type="checkbox"/> 6-10 years | <input type="checkbox"/> Greater than 30 years |
| <input type="checkbox"/> 11-15 years | |

SMALL ANGLE GRINDERS

- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- | | |
|--|--|
| <input type="checkbox"/> Less than 2 years | <input type="checkbox"/> 16-20 years |
| <input type="checkbox"/> 2-5 years | <input type="checkbox"/> 21-30 years |
| <input type="checkbox"/> 6-10 years | <input type="checkbox"/> Greater than 30 years |
| <input type="checkbox"/> 11-15 years | |

ROAD BREAKERS
e.g Jackhammers



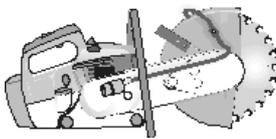
*Average time per day
(this should be trigger time)*

- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

*Total number of years tool
used*

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

DISC CUTTER/ STONE SAW
e.g Stihl Saws



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

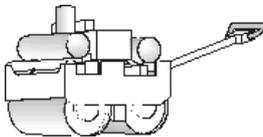
VIBRATING COMPACTION PLATE
e.g Wacker plates



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

HAND-GUIDED ROLLERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

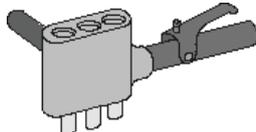
VIBRATING POKER



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

SCABBLER (Piston type)



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

RAMMERS



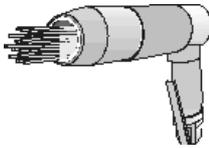
*Average time per day
(this should be trigger time)*

- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

*Total number of years tool
used*

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

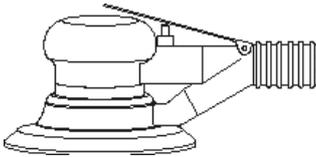
NEEDLE SCALERS
e.g Needle gun, Descaling guns



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

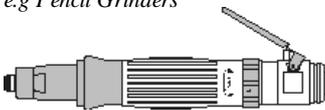
SANDERS AND POLISHERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

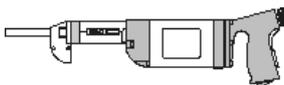
DIE GRINDERS
e.g Pencil Grinders



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

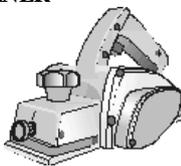
SAWS AND FILES



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

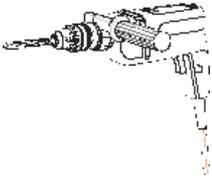
PLANER



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

IMPACT DRILLS



*Average time per day
(this should be trigger time)*

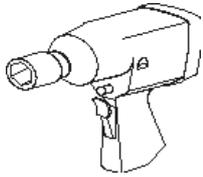
- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

*Total number of years tool
used*

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

WRENCHES

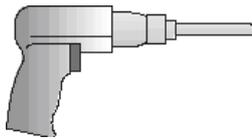
e.g Impact wrench, bolt guns, nut guns, nut runners, air spanners, ratchets, bance



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

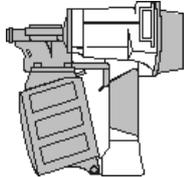
RIVETING HAMMERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

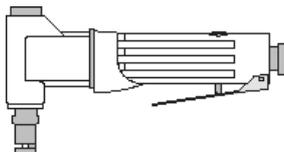
NAIL GUNS AND POT RIVETERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

NIBBLERS AND SHEARS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

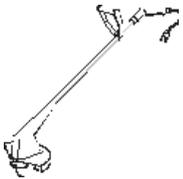
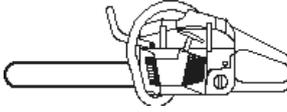
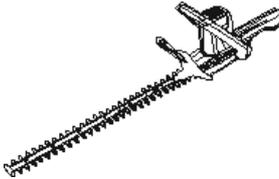
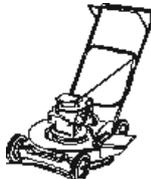
- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

FLOOR POLISHERS

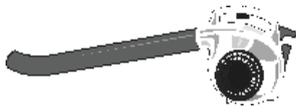


- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

	<i>Average time per day (this should be trigger time)</i>	<i>Total number of years tool used</i>
BRUSH CUTTERS AND STRIMMERS 	<input type="checkbox"/> Less than 15 mins <input type="checkbox"/> 15 to 60 mins <input type="checkbox"/> 1 to 2 hours <input type="checkbox"/> 2 to 4 hours <input type="checkbox"/> More than 4 hours	<input type="checkbox"/> Less than 2 years <input type="checkbox"/> 2-5 years <input type="checkbox"/> 6-10 years <input type="checkbox"/> 11-15 years <input type="checkbox"/> 16-20 years <input type="checkbox"/> 21-30 years <input type="checkbox"/> Greater than 30 years
CHAINSAWS 	<input type="checkbox"/> Less than 15 mins <input type="checkbox"/> 15 to 60 mins <input type="checkbox"/> 1 to 2 hours <input type="checkbox"/> 2 to 4 hours <input type="checkbox"/> More than 4 hours	<input type="checkbox"/> Less than 2 years <input type="checkbox"/> 2-5 years <input type="checkbox"/> 6-10 years <input type="checkbox"/> 11-15 years <input type="checkbox"/> 16-20 years <input type="checkbox"/> 21-30 years <input type="checkbox"/> Greater than 30 years
HEDGE CUTTERS 	<input type="checkbox"/> Less than 15 mins <input type="checkbox"/> 15 to 60 mins <input type="checkbox"/> 1 to 2 hours <input type="checkbox"/> 2 to 4 hours <input type="checkbox"/> More than 4 hours	<input type="checkbox"/> Less than 2 years <input type="checkbox"/> 2-5 years <input type="checkbox"/> 6-10 years <input type="checkbox"/> 11-15 years <input type="checkbox"/> 16-20 years <input type="checkbox"/> 21-30 years <input type="checkbox"/> Greater than 30 years
MOWERS 	<input type="checkbox"/> Less than 15 mins <input type="checkbox"/> 15 to 60 mins <input type="checkbox"/> 1 to 2 hours <input type="checkbox"/> 2 to 4 hours <input type="checkbox"/> More than 4 hours	<input type="checkbox"/> Less than 2 years <input type="checkbox"/> 2-5 years <input type="checkbox"/> 6-10 years <input type="checkbox"/> 11-15 years <input type="checkbox"/> 16-20 years <input type="checkbox"/> 21-30 years <input type="checkbox"/> Greater than 30 years
SCARIFIERS 	<input type="checkbox"/> Less than 15 mins <input type="checkbox"/> 15 to 60 mins <input type="checkbox"/> 1 to 2 hours <input type="checkbox"/> 2 to 4 hours <input type="checkbox"/> More than 4 hours	<input type="checkbox"/> Less than 2 years <input type="checkbox"/> 2-5 years <input type="checkbox"/> 6-10 years <input type="checkbox"/> 11-15 years <input type="checkbox"/> 16-20 years <input type="checkbox"/> 21-30 years <input type="checkbox"/> Greater than 30 years
ROTA VATORS 	<input type="checkbox"/> Less than 15 mins <input type="checkbox"/> 15 to 60 mins <input type="checkbox"/> 1 to 2 hours <input type="checkbox"/> 2 to 4 hours <input type="checkbox"/> More than 4 hours	<input type="checkbox"/> Less than 2 years <input type="checkbox"/> 2-5 years <input type="checkbox"/> 6-10 years <input type="checkbox"/> 11-15 years <input type="checkbox"/> 16-20 years <input type="checkbox"/> 21-30 years <input type="checkbox"/> Greater than 30 years

BLOWERS



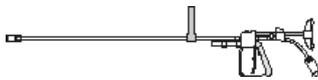
*Average time per day
(this should be trigger time)*

- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

*Total number of years tool
used*

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

HIGH PRESSURE WATER JET

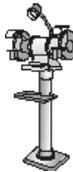


- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

HAND-FED/FLOOR MOUNTED MACHINES

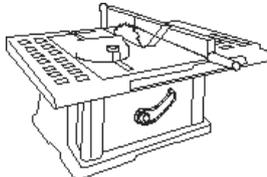
PEDESTAL GRINDERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

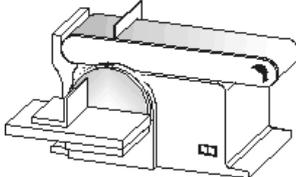
BENCH SAWS AND BAND SAWS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

LINISHERS, POLISHERS AND BELT SANDERS



- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

*Average time per day
(this should be trigger time)*

*Total number of years tool
used*

FLOOR MOUNTED NIBBLERS

- Less than 15 mins
- 15 to 60 mins
- 1 to 2 hours
- 2 to 4 hours
- More than 4 hours

- Less than 2 years
- 2-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-30 years
- Greater than 30 years

OTHERS

If you use other vibration producing tools which are not included in the list above please give details below.

Thank you very much for your time. Please return to Dr Kerry Poole (Health Effects Section, Health and Safety Laboratory, Harpur Hill, Buxton. SK17 9JN) in the FREEPOST envelope provided.

Upper limb disability and exposure to hand-arm vibration in selected industries

There is a need for evidence-based intelligence related to ill-health caused by exposure to vibration that could be used to benchmark the extent of disease and allow assessment of changes over time. This ideally requires simple, validated and cheap tools that can be administered easily across all industries. The Disability of the Arm, Shoulder and Hand (DASH) questionnaire is one instrument that may be useful.

The emphasis of HSE's Noise and Vibration Programme has been on the health outcome of hand-arm vibration syndrome (HAVS), which is by definition causally associated with cumulative hand-transmitted vibration exposure. However, individuals with HAVS may also have other musculoskeletal disorders, which may or may not be a consequence of vibration exposure, but that will contribute to their overall disability.

The study reported here involved the application of the DASH questionnaire to a population working with hand-held vibrating tools, whilst collecting simple information related to industry, trade, tools used, vibration exposure, known health problems and symptoms in the upper limbs. Following discussion with appropriate HSE colleagues four industries were selected for study: Gardening; Manufacture of Basic Metals, Construction and Motor Vehicle Repair.

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