Gathering intelligence from referrals to HSL for hand-arm vibration syndrome

Prepared by the Health and Safety Laboratory for the Health and Safety Executive 2010
This report details three separate pieces of work, which are linked by the fact that they involve surveying individuals assessed for hand-arm vibration syndrome (HAVS) at the Health and Safety Laboratory (HSL), or the customers responsible for referring them. The first part of the work involved surveying customers who had referred individuals to HSL over the preceding year to obtain more information regarding the prevalence and incidence of HAVS in the workforces from which the referrals are drawn. The second part of the work surveyed individuals who had attended the HAVS centre since around the time of the implementation of the Control of Vibration at Work regulations (2005), to establish what had happened to them in terms of their employment status and medical referral. The final part constituted a longitudinal follow-up study of individuals who had previously taken part in a study investigating upper limb disability and quality of life in HAVS referrals in 2003. These individuals were surveyed again in 2009 (mean follow-up time 5.5 years), following the implementation of the new regulations, to establish if there had been any change in their disability or quality of life status.

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EXECUTIVE SUMMARY

This report details three separate pieces of work, which are linked by the fact that they involve surveying individuals assessed for hand-arm vibration syndrome (HAVS) at the Health and Safety Laboratory (HSL), or the customers responsible for referring them. The first part of the work involved surveying customers who had referred individuals to HSL over the preceding year to obtain more information regarding the prevalence and incidence of HAVS in the workforces from which the referrals are drawn. The second part of the work surveyed individuals who had attended the HAVS centre since around the time of the implementation of the Control of Vibration at Work regulations (2005), to establish what had happened to them in terms of their employment status and medical referral. The final part constituted a longitudinal follow-up study of individuals who had previously taken part in a study investigating upper limb disability and quality of life in HAVS referrals in 2003. These individuals were surveyed again in 2009 (mean follow-up time 5.5 years), following the implementation of the new regulations, to establish if there had been any change in their disability or quality of life status.

Objectives

1. To obtain an estimate of the prevalence of HAVS in the populations from which HSL obtains referrals.
2. To obtain information from our customer base about new incidence of HAVS over the last 2 years.
3. To establish what happens to an individual once they have received a diagnosis at the assessment centre in terms of employment status, changes in their job and referral for further testing.
4. To establish whether disability and quality of life has changed over a five and a half year period (2003-2009) and what factors are associated with this.

Main Findings

1. Good response rates were obtained for all three parts of this work (44%, 33% and 46% respectively).
2. The mean prevalence of HAVS in the working population from which individuals were referred was 13.5% and the mean incidence over the last two years was 2.4%.
3. Parts 2 and 3 of the study (which involved different individuals) showed that the majority of individuals who had been referred to HSL for HAVS assessment as part of their health surveillance remained in employment following this (83% and 80% respectively). Eighty-seven percent of these were still in the same job.
4. There was no evidence that the severity of HAVS affected whether an individual was employed or not.
5. In those who were still employed, 13% had changed their job. The severity of HAVS was related to whether an individual had changed job. Those with more severe HAVS were more likely to change their job, and 50% felt that this change in their job was as a result of their HAVS assessment.
6. Seventy-four percent of those who were in the same job reported that their vibration exposure had reduced. Eighty-nine percent of these felt that this reduction in exposure was a consequence of their HAVS assessment. The overall reduction in exposure was not significantly related to the severity of HAVS, however there were 18 individuals (36%) who had a severity of HAVS at which it would be expected that action would be taken to reduce exposure.

7. Of those who reported that they were still in the same job, but that their tool use had not changed (n=18), 3 were at a more severe stage of HAVS where it would normally be anticipated that they would need protection (removal or significantly lower exposure).

8. Sixty-one percent of the cohort reported that the problems with their hands had not changed between their HAVS assessment and follow-up, 10% felt that their hands had improved and 21% felt that their hands had got worse.

9. Overall, there was a fall in disability score over the 5.5 year follow-up period, suggesting that on the whole the level of disability had reduced in those with HAVS. However, there was a wide range of changes in disability over the follow-up period, with more individuals showing improvement in disability score, rather than a worsening in disability score. However, no factor could be identified that could explain these wide changes or overall improvement.

**Conclusions**

All of the individuals involved in this study were under a health surveillance scheme for hand-arm vibration. Clearly, there may be factors (e.g. economic environment), other than health surveillance, that may be important in determining changes in employment and vibration exposure.

Following assessment at HSL, as part of their health surveillance, the majority of individuals have remained employed in the same job, and this seems to be generally appropriate in relation to the severity of HAVS. Where this has occurred, the majority of individuals generally report that their exposure to vibration has been reduced, which they feel is a consequence of their assessment at HSL. Therefore, it appears that action is being taken to control exposure following HAVS assessment.

Overall, there was no evidence that disability got worse over time in relation to HAVS. However, how changes in disability relate to changes in HAVS staging, vibration exposure and other measures of abnormality (e.g. vibrotactile measurement) is unclear.

**Recommendations**

There is a lack of longitudinal data related to outcomes (both employment and medical) in HAVS cases. Whilst the present study was able to obtain some longitudinal information it was not possible to collect accurate information on factors that may influence changes in disability (e.g. vibration exposure, staging of disease). The longitudinal HAVS study, which is currently taking place, will provide information to better understand these factors and provide future guidance on management of cases in the workplace.
The current study focussed on those individuals referred to HSL for HAVS assessment. The Occupational Health Providers and employers of those referred may not necessarily be typical of the wider HAVS community. Therefore, the positive outcomes related to employment status and actions in reducing vibration exposure in the present study may not be applicable to all populations undergoing HAVS health surveillance. Similar information from other populations would be useful.
1 INTRODUCTION

The Health and Safety Laboratory runs a specialist hand-arm vibration syndrome (HAVS) centre that takes referrals from Occupational Health Providers (OHPs) to provide a specialist diagnostic service. An intelligence database containing detailed information on over 650 referrals to the HAVS assessment unit at HSL \(^2\) has been established over recent years. This contains cases that were referred to HSL between the periods of November 1999 and July 2006. It includes details on the severity of disease, vibration exposure, tools, trades, occupations and industries these individuals come from. We are not aware of any other data source that can provide this type of intelligence information and therefore this is a very useful data source. However, one potential limitation of this database is that it simply contains information related to the referrals with potential HAVS we receive, and that we do not have any information regarding the working population from which these individuals are drawn. Consequently, estimation of the prevalence of disease is not currently possible from these data. In the first part of the current study we sought to update the intelligence database to include referrals from August 2006 to January 2009, and obtain information from our customers to allow the prevalence and new incidence of HAVS to be estimated in our referral population.

Hand-arm vibration syndrome is a long latency disease and according to HSE guidance individuals are still able to work with vibrating tools when disease is mild but should stop working with these tools when disease progresses, or is likely to progress, to disabling or severe disease \(^3\). Consequently, it is conceivable that in certain industries there are a large proportion of individuals working with vibrating tools who have HAVS. However, little seems to be known about what actually happens to individuals once they have been given a diagnosis of HAVS. Are individuals simply redeployed or made unemployed when they have been given such a diagnosis, even in mild disease? Clearly, this may represent a large cost and have a large impact on UK industry, but it will also have a profound effect upon the individuals themselves. In the second part of the current study we have followed-up individuals who attended the centre between January 2005 and January 2009 with a short questionnaire to establish what has happened to them since their assessment in terms of their employment status, medical referral, vibration exposure and self-perceived changes in disease.

Datasets such as The Health and Occupational Reporting (THOR) network or the HSL database give information about new cases or incidence of disease, but do not give information regarding the progression of disease and factors that influence this. Little is known about the progression of disease over time. In 2003 we conducted a cohort study aimed at establishing disability and quality of life in individuals with HAVS \(^4,5\). This study showed that disability, as measured by the Disability of the Arm, Shoulder and Hand (DASH) questionnaire, was related to the severity of HAVS, and it was the sensorineural component of HAVS that was most disabling \(^4,5\). In the third part of the current study we have followed-up these individuals, some five and a half years later, to establish how their disability and quality of life has changed over that period. Factors that may influence these changes have been explored including initial diagnosis, employment status and self-reported vibration exposure.

The overall aims of this study were:

1. To obtain an estimate of the prevalence of HAVS in the populations from which HSL obtains referrals.

2. To obtain information from our customer base about new incidence of HAVS over the last 2 years.
3. To establish what happens to an individual once they have received a diagnosis at the assessment centre in terms of employment status, changes in their job and referral for further testing.

4. To establish whether disability and quality of life has changed over a five and a half year period (2003-2009) and what factors are associated with this.

**Figure 1** Overview of the study design

<table>
<thead>
<tr>
<th>Time frame of HAVS referrals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
</tr>
</tbody>
</table>

- cohort included in initial study on disability in HAVS
- cohort included in employment and health status study
- survey of employment and health status
- follow-up of disability cohort

Section 2 of report

Section 3 of report

Section 4 of report
2 PART 1: CUSTOMER SURVEY

2.1 AIMS

1. To obtain an estimate of the prevalence of HAVS in the populations from which HSL obtains referrals.

2. To obtain information from our customer base about new incidence of HAVS over the last 2 years.

2.2 METHODS

A list of customers who had referred individuals to the HAVS assessment centre between January 2008 and April 2009 was drawn up. Each of these customers was then contacted by telephone and electronic mail to complete three key questions:

1. How many individuals do you have who receive health surveillance for vibration exposure?

2. How many cases of HAVS do you have in the workforce at present (in total, not just those referred to HSL)?

3. How many new cases of HAVS have you had over the last two years and has the number you have under health surveillance changed?

2.3 RESULTS

There were 48 customers who had referred individuals to the HAVS assessment centre over the selected period. Of these, 21 (44%) agreed, or felt able, to answer the questions regarding the workforce under health surveillance for HAVS. Fourteen companies (66%) were able to answer all the questions, other companies answered one or two of the questions. The 14 companies who answered all the questions looked after 3,686 individuals under health surveillance for HAVS. Overall, from the 14 companies who gave complete information the mean prevalence of HAVS was 13.5% (Figure 2) and the mean incidence over the last two years was 2.4%. When all of the information collected was included then a total of 8,216 individuals were covered by health surveillance from these companies and around 79 new cases of HAVS had been detected over the last two years.
**Figure 2** Prevalence of HAVS in those companies agreeing to provide information regarding employees under health surveillance for HAVS

**Main findings**

- There was a good response rate to the survey of 44%.
- Of those companies who answered all the questions an average prevalence of HAVS of 13.5% was measured.
- The mean incidence of HAVS over the last two years was 2.4%.
3 PART 2: EMPLOYMENT STATUS AND FURTHER DIAGNOSIS OF REFERRALS TO HSL

3.1 AIM

To establish what happens to an individual once they have received a diagnosis at the HSL assessment centre in terms of employment status, changes in their job and referral for further testing.

3.2 STUDY DESIGN

A cohort of referrals who had been referred to HSL for a HAVS assessment were followed up at a later date by self-administered, postal questionnaire concerning their employment status, and any further medical assessments or problems that had arisen. Between April and June 2009 follow-up questionnaires were sent to all workers who had undergone a HAVS assessment at HSL from January 2005 until January 2009.

This study was approved by HSE’s Research Ethics Committee (ETHCOM/REG/09/02).

3.3 QUESTIONNAIRE DESIGN

A questionnaire was designed for the study using a commercially available software package (Sphinx Survey v4.5) (Appendix 1). The first part of the questionnaire contained questions related to information they had been given about their health status subsequent to assessment at HSL, followed by questions about any subsequent medical referral and the outcome. The second part of the questionnaire covered changes in the employment and job status in the follow-up period. Individuals were asked to complete the questionnaire as completely as possible and return in a FREEPOST envelope provided. If individuals did not return the questionnaire within one month of mailing they were sent a second questionnaire as a reminder. If they still did not respond they were not contacted again.

3.4 DATA ANALYSIS

The outcomes from the questionnaire and available data on the cohort from the HAVS assessment at HSL were combined to form a single database. These results were analysed (Medcalc v10, Belgium) by standard statistical techniques including categorical data analysis e.g. Chi-square and logistic regression analysis. Where appropriate the variable length of follow-up (time between assessment and completion of the questionnaire) was used as an explanatory variable.
3.5 RESULTS

3.5.1 Response rate and follow-up time

A total of 289 questionnaires were mailed and 99 responses were received (response rate 34%). Of the 99 responses received 96 were completed in such a way that they could be analysed. These ninety-six questionnaires are described as the ‘cohort’. The time between their assessment at HSL and follow-up questionnaire was between 75-1665 days with a mean of 841 days (approximately 2.3 years). The 5th-95th percentile in distribution of follow-up periods was 9 months-4.5 years.

3.5.2 Description of the cohort at the time of assessment at HSL

The mean age of the cohort at the time of their assessment at HSL was 48.5 years (SD 8.4; range 31-64 years). They had been exposed to hand-arm vibration for a mean of 26.3 years (SD 10.0; range 2-49 years).

While the occupations of the individuals were not formally coded according to classification criteria [6], a breakdown of the major categories of their main trade given at assessment at HSL are shown in table 1. The referrals in the cohort were employed across forty-eight different employers.

<table>
<thead>
<tr>
<th>Main trade</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadworkers, highway maintenance, street masons, utility workers</td>
<td>19</td>
</tr>
<tr>
<td>Gardeners, landscapers, tree surgeons and groundsmen</td>
<td>15</td>
</tr>
<tr>
<td>Fitters, maintenance fitters</td>
<td>8</td>
</tr>
<tr>
<td>Cable jointers, linesmen, electricians</td>
<td>5</td>
</tr>
<tr>
<td>Mechanics, transport</td>
<td>4</td>
</tr>
<tr>
<td>Sheet metal worker, welders and rivitters</td>
<td>4</td>
</tr>
<tr>
<td>Plumbers</td>
<td>3</td>
</tr>
<tr>
<td>Stone masons</td>
<td>2</td>
</tr>
<tr>
<td>Mechanical engineers</td>
<td>2</td>
</tr>
<tr>
<td>Bricklaying</td>
<td>2</td>
</tr>
<tr>
<td>Coachbuilders</td>
<td>2</td>
</tr>
</tbody>
</table>

In terms of HAVS assessment at HSL, 72% (69/96) were given a diagnosis that involved either HAVS or a presumptive diagnosis of Carpal Tunnel syndrome (CTS), based on reported symptoms and signs of positive Tinel’s and Phalen’s tests. A breakdown of diagnostic categories at HSL is shown in table 2.
Table 2  A breakdown of the diagnoses and presumptive diagnoses at HSL for the cohort

<table>
<thead>
<tr>
<th>HSL diagnosis</th>
<th>Number</th>
<th>Proportion in cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand-arm vibration syndrome only</td>
<td>38</td>
<td>39.6%</td>
</tr>
<tr>
<td>Hand-arm vibration with carpal tunnel syndrome</td>
<td>21</td>
<td>21.9%</td>
</tr>
<tr>
<td>Carpal tunnel syndrome</td>
<td>10</td>
<td>10.4%</td>
</tr>
<tr>
<td>Raynaud’s non-vibrational</td>
<td>4</td>
<td>4.2%</td>
</tr>
<tr>
<td>Residual symptoms from damage to the hands/arms</td>
<td>5</td>
<td>5.2%</td>
</tr>
<tr>
<td>Thoracic outlet syndrome</td>
<td>3</td>
<td>3.1%</td>
</tr>
<tr>
<td>Nerve entrapment in wrist, elbow, neck</td>
<td>3</td>
<td>3.1%</td>
</tr>
<tr>
<td>Medication and anxiety state</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Dupuytren’s disease</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Autoimmune disease –Sjogren’s syndrome</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Epicondylitis</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Gout or pseudogout</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Hypothyroidism, Arteriosclerosis</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Abnormality in ulnar arterial blood flow</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Muscle hypertrophy</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Peripheral neuropathy</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Scleroderma with systemic sclerosis in association with silicosis</td>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>Work related upper limb disorder</td>
<td>1</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Fifty-nine individuals in the cohort were given a diagnosis involving HAVS. The severity of HAVS in each hand was assessed using the internationally agreed Stockholm Workshop scale (SWS) [3]. The staging for the 59 individuals in the cohort, subdivided by dominant and non-dominant hand is shown in figure 3. Few subjects were at stage 3 SWS for either neurosensory or vascular components of HAVS. There was a strong statistical association in the severity of HAVS between the dominant and non-dominant hands for both neurosensory and vascular Stockholm Workshop staging (Chi-square=85.9, p<0.0001, contingency coefficient = 0.77; Chi square=110.0, p<0.0001, Contingency coefficient=0.81 respectively). This suggests that the degree of HAVS severity as defined by the Stockholm Workshop scale tended to be symmetrical in both hands.
**Figure 3** Distribution of Stockholm Workshop staging in the 59 subjects assessed at HSL as having HAVS.

SV denotes vascular staging; SN denotes sensorineural staging. The amended Stockholm Workshop scale (L140, HSE), where stage 2 is split into ‘early’ and ‘late’, is not used within this analysis, as some of the early referrals were not given a vascular staging according to the amended scaling.

### 3.5.3 Feedback to subjects after assessment at HSL

In all cases, HSL was undertaking a HAVS assessment on behalf of those who had the health surveillance responsibility for the subject. Therefore it was not the responsibility of HSL to inform the subject of the outcome of their HAVS assessment. In practice, many individuals were likely to be informed of their diagnosis by the physician at HSL. However, as part of this survey we were interested in the feedback that the individual received from their employer or company doctor or nurse under their programme of health surveillance. Consequently, the question that individuals were asked to answer was ‘Following your HAVS assessment at HSL, were you told what the outcome was by your employer, company doctor/nurse or GP’. There is the possibility of some misclassification as an individual may have found it difficult to recall whether their own occupational health physician, or the physician at HSL, gave them the information.

Seventy-eight percent of the cohort (n=96) reported that they had been told the outcome of their HAVS assessment by either their occupational health professional, employer or GP. Of those who were informed of the outcome, 71% reported that they had been told they had ‘HAVS’; while 44% reported that they might have some other condition. This included 27% who were told that they suffered from CTS, two subjects who were told they had thoracic outlet syndrome, and eleven others (14%) who reported being told they had other diagnostic outcomes.

The data suggests that largely the medical outcome of their HAVS assessments carried out at HSL were fed back to the cohort.
3.5.4 Overall changes in employment status, job and tool use

The changes in the cohort’s employment status and their use of vibrating tools are shown diagrammatically in figure 4. Significantly more of the cohort was still in employment than unemployed (83% versus 17%; p<0.0001). Similarly 87% (68/78) of those still in employment reported that they were still undertaking the same job, with a large proportion (74%) of these workers reporting either stopping tool use, reducing tool use, or using lower emission vibrating tools. Among this latter group of workers whose vibration exposure had reduced or even stopped, 89% reported that they felt this was as a result of their HAVS assessment.

Of those that were still employed but had changed jobs (n=10), the majority had been re-deployed within their company (n=6), with a minority having been made redundant (n=2) but finding employment elsewhere. Fifty percent of those who were re-deployed or were made redundant reported that they felt that these outcomes were as a result of their HAVS assessment.
**Figure 4** Schematic representation of employment and job status within the cohort^ from the follow-up questionnaire

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### Employment changes

- **Cohort n=94**
  - **Employed**
    - **Currently Employed?**
      - **YES**
        - **Employed n=78 (83%)**
      - **NO**
        - **Unemployed n=16 (17%)**
  - **Changed jobs**
    - **NO**
      - **Same job n=68**
    - **YES**
      - **Same job?**
        - **YES**
          - **Same use of tools?**
            - **YES**
              - **Time of tool use reduced n=27 *
            - **NO**
              - **Retired due to age n=4**
        - **NO**
          - **Retired due to ill-health n=3 **
          - **Other n=3 **
    - **No Change**
      - **n=18**
      - **Same use of tools?**
        - **YES**
          - **Stopped using vibrating tools n=23 *
        - **NO**
          - **In same firm?**
            - **YES**
              - **Redeployed n=6 ***
            - **NO**
              - **Made redundant n=2 ***
              - **wished to change job n=1**

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* 89% of these subject felt that the outcome was as a result of their HAVS assessment
** 50% of these subjects felt that the outcome was as a result of their HAVS assessment
*** 50% of these subjects felt that the outcome was as a result of their HAVS assessment

^ Ninety-four subjects are stated as the ‘cohort’ here as two subjects gave ambiguous questionnaire responses about their current employment status.
The distribution of Stockholm workshop grading (Figure 5) for an individual’s most affected hand were then identified for four key groups, namely:-

- those who were unemployed at the time of follow-up;
- those employed subjects whose jobs had altered either by way of redeployment or redundancy;
- those who were in the same job and who reported that their vibration exposure had not changed, and;
- those who were in the same job and who reported that their vibration exposure had reduced or been eliminated.
Figure 5 Schemata relating the employment and job status to the SWS staging (pink boxes) for the most affected hand assessed at HSL
The data in figure 5 suggests that those employed workers whose jobs had changed by redeployment or redundancy since their HAVS assessment at HSL had vascular or sensorineural staging in their most affected hand at least at SWS stage 2 or higher. These findings are compatible with current guidance that within SWS stage 2 alterations may need to be made to reduce or remove a worker from further exposure to vibration.

For those workers still in the same jobs and reporting no change in their vibrating tool use since their assessment at HSL, 67% (12/18) were stage 1 or less, and 61% (11/18) were without symptoms of HAVS at their assessment at HSL. However, a third (6/18) had been reported as 2Sn early or 2V in their worst staged hand.

For those workers in the same job who reported their vibration exposure as reduced or stopped since their HAVS assessment at HSL, 54% (27/50) were either 2Sn early or 2V or higher, but interestingly 46% (23/50) were SWS stage 1 or less; including 30% who were without symptoms of HAVS. These data may indicate that since 2005 there had been some action to reduce vibration exposure, whether significant levels of HAVS were present or not. While this group did not simply seem to reflect subjects removed from exposure due to the severity of their HAVS staging, 89% of those reporting reduced or eliminated vibration exposure felt that the outcome was related to their HAVS assessment. In fact there was a significant relationship and trend (Chi-square and trend; both p=0.02) between the worst Stockholm staging (vascular or neurosensory) in either hand and whether the subject felt that intervention in changing vibration exposure was related to the HAVS assessment.

The severity of HAVS staging in the unemployed subjects suggested that HAVS was not a key driver of unemployment in this cohort.

Further analyses below investigated whether the HAVS diagnosis at HSL were statistically significantly associated with poorer employment status on follow-up, led to a change in jobs or vibrating tool use.

### 3.5.5 Was employment status (employed/unemployed) at follow-up related to individuals' HAVS diagnosis at HSL?

Table 3 shows the cross-tabulation of employed and unemployed subjects against the sum of either their vascular or sensorineural SWS staging across both hands. There is little data to support the idea that more severe Stockholm Workshop staging is associated with poorer employment status. Although there is some weak evidence (p=0.035) that there is some trend in higher vascular staging being associated with unemployed status.
Table 3 Cross-tabulation of SWS summed across hands by employment status

<table>
<thead>
<tr>
<th>SWS sum across hands</th>
<th>Vascular staging</th>
<th>Sensorineural staging</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Employed</td>
<td>Non-Employed</td>
</tr>
<tr>
<td>0</td>
<td>43</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*calculated using HSE’s amended Stockholm workshop scale, i.e. including early and late stage 2 [3]. The staging for each hand was given a score for either the sensory or vascular component (0V or 0Sn = 0; 1V or 1Sn = 1; 2Vearly or 2Sn early = 2; 2Vlate or 2Sn late = 3 and 3V or 3Sn = 4). The sum of the scores for both hands was calculated separately for the sensory and vascular components.

A further logistic regression analysis was undertaken using summed vascular SWS staging and sensorineural SWS staging across the hands, age, date between assessment and questionnaire return, and presumptive diagnosis of CTS as explanatory variables for employment status. A weak but significant model was apparent (p=0.04), but only the age variable (p=0.035) showed a significant influence on employment status.

These analyses further confirm that a HAVS diagnosis at HSL was not a significant driver of whether the subject was employed or not at the time of the follow-up questionnaire.

3.5.6 Was job status at follow-up related to individuals’ HAVS diagnosis at HSL?

Table 4 below cross-tabulates the summed sensorineural and vascular SWS staging across both hands against whether subjects are in the same job, or have changed job during the follow-up period. Both for vascular and the sensorineural elements of HAVS, there is strong evidence that more severe staging is associated with a change in job.
Table 4 Cross-tabulation of SWS summed across hands by job status

<table>
<thead>
<tr>
<th>SWS sum across hands</th>
<th>Vascular staging</th>
<th>Sensorineural staging</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Same job</td>
<td>Changed job</td>
</tr>
<tr>
<td>0</td>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8*</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

*calculated using HSE’s amended Stockholm workshop scale, i.e. including early and late stage 2 [3]. The staging for each hand was given a score for either the sensory or vascular component (0V or 0Sn = 0; 1V or 1Sn = 1; 2Vearly or 2Sn early = 2; 2Vlate or 2Sn late = 3 and 3V or 3Sn = 4). The sum of the scores for both hands was calculated separately for the sensory and vascular components.

A logistic regression (table 5) was also undertaken to investigate whether individuals’ HAVS assessment at HSL influenced their remaining in the same job. This again used explanatory variables of summed vascular and summed sensorineural Stockholm workshop stages across the hands, age, date between assessment and questionnaire return, and presumptive diagnosis of CTS as explanatory variables. The model was highly significant (p=0.007) with higher degrees of severity of both vascular and sensorineural staging being associated with the likelihood of a change in job.

Table 5 Logistic regression model to explain Job Status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std.Error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall model</td>
<td></td>
<td></td>
<td>0.0007</td>
</tr>
<tr>
<td>Variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.0265</td>
<td>0.04565</td>
<td>0.5616</td>
</tr>
<tr>
<td>Summed Stockholm Workshop Sn_severity</td>
<td>0.3820</td>
<td>0.1759</td>
<td>0.02986</td>
</tr>
<tr>
<td>Summed Stockholm Workshop V_severity</td>
<td>0.4380</td>
<td>0.1893</td>
<td>0.02067</td>
</tr>
<tr>
<td>Time between assessment and follow-up</td>
<td>0.0002223</td>
<td>0.0007985</td>
<td>0.7807</td>
</tr>
<tr>
<td>Do_they_have_CTS?</td>
<td>1.1287</td>
<td>0.7118</td>
<td>0.1128</td>
</tr>
<tr>
<td>Constant</td>
<td>-5.4089</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These findings are compatible with intervention within health surveillance to reduce exposure or remove from exposure, with consideration given to redeployment if possible.
3.5.7 Were perceived changes in the use of vibrating tools for those in the same jobs related to their HAVS diagnosis at HSL?

A logistic regression (table 6) was also undertaken to investigate whether there was any evidence that the HAVS assessment at HSL influenced the vibrating tool use of those individuals who have stayed in the same job. This again used explanatory variables of summed vascular and sensorineural SWS staging, age, date between assessment and questionnaire return, and presumptive diagnosis of CTS as explanatory variables. The dependent variable was whether subjects’ felt that their tool use was the same as prior to their HAVS assessment, or had lessened. The overall model fit was only just significant (p=0.0406), and the presumptive diagnosis of CTS was around the significance level for an individual variable (p=0.052). This analysis strengthens the concept that reductions in vibration were not simply being applied to those workers with more severe stages of HAVS, but seemed to be a more general phenomenon and prevalent across the firms represented.

Table 6 logistic regression to explain change of tool use in those in the same jobs

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std.Error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall model</td>
<td></td>
<td></td>
<td>0.0406</td>
</tr>
<tr>
<td>Age</td>
<td>-0.01477</td>
<td>0.04065</td>
<td>0.7164</td>
</tr>
<tr>
<td>Summed Stockholm Workshop Sn_severity</td>
<td>0.1872</td>
<td>0.2214</td>
<td>0.3978</td>
</tr>
<tr>
<td>Summed Stockholm Workshop V_severity</td>
<td>0.2916</td>
<td>0.2441</td>
<td>0.2323</td>
</tr>
<tr>
<td>Time between assessment and follow-up</td>
<td>0.001159</td>
<td>0.0007331</td>
<td>0.1140</td>
</tr>
<tr>
<td>Do_they_have_CTS?</td>
<td>1.7120</td>
<td>0.8814</td>
<td>0.0521</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.2145</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.5.8 Did subjects report changes in the extent of perceived problems in their hands over the follow-up period?

The questionnaire asked whether subjectively cohort members thought that problems in their hands had changed between their assessment at HSL and completing the follow-up questionnaire. Sixty-one percent (57/94) stated their hands had not changed; while 10% (10/98) stated that their hands had improved and 21% (27/94) stated their hands had got worse. For those individuals who reported a change in their hands, there was some evidence that more had reported their hands getting ‘worse’ than ‘better’ (p=0.0085, Fishers exact test). There was no significant association (p>0.05) between the SWS staging in the most affected hand at the initial HSL assessment and subjective changes in hand problems over the follow-up period. Similarly there was no evidence that the categories of subjective changes in hand problems were associated with employment status, whether the worker was in the same job or generally with vibrating tool use categorised into ‘No tool use’, Less vibrating tool use’ or ‘same level of vibrating tool use’.

3.5.9 Were there changes in smoking status over the follow-up period?

Smoking has been associated particularly with the vascular component of HAVS, and the frequency of blanching attacks in those with vascular HAVS [7]. It is routine for occupational
health professionals to stress to HAVS sufferers about giving up smoking. Sixty-nine percent of the cohort were non-smokers at the time of their HAVS assessment at HSL, which had increased to 75% at follow-up. A further 12% claimed to have reduced their smoking. Only one individual admitted to smoking more than at the time of the assessment at HSL.

**Table 7** Smoking status stratified by whether subjects has a diagnosis of HAVS (neurosensory or vascular)

<table>
<thead>
<tr>
<th></th>
<th>HAVS yes</th>
<th>HAVS No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-smoker</td>
<td>40</td>
<td>26</td>
</tr>
<tr>
<td>Smoking more</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Smoking the same</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Smoking reduced</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Smoking stopped</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

There was no evidence of a significant change in smoking habits over the follow-up period when comparing individuals with or without a diagnosis of HAVS at HSL (p>0.05).

**3.5.10 Is there some pattern to suggest why some workers were referred for further medical investigations after assessment at HSL?**

The questionnaire asked whether individuals had been referred for further medical assessment after their referral to HSL. Around 28% of this cohort had gone on to have further medical investigations during the follow-up period.

Those individuals that had undergone ‘further medical referrals’ did not show any poorer employment outcomes; 85% of those undergoing further medical referral were in employment at the time of follow-up compared to 84% in the overall cohort.

**Table 8 shows the breakdown of further medical referrals by diagnosis category at HSL**

<table>
<thead>
<tr>
<th>Diagnosis category</th>
<th>Medical referral after HSL (n)</th>
<th>Total in cohort (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAVS</td>
<td>9</td>
<td>38</td>
</tr>
<tr>
<td>HAVS + CTS*</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>CTS*</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Raynaud’s non-vibrational</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Residual symptoms from previous damage to hands/arms</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Thoracic outlet syndrome (TOS)*</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Nerve entrapment on wrist, elbow or neck *</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Other diagnoses*</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

* indicates that only a presumptive diagnosis is possible from the HSL assessment.
Although those with a simple, presumptive CTS diagnosis at HSL appeared to show a greater % referred for further investigation, this did not reach statistical significance. It is interesting that only around 25% of those diagnosed with HAVS and CTS underwent further investigation even though the report from HSL would have noted a CTS diagnosis that was often largely presumptive and would need further investigation to confirm. Surprisingly, around 25% of those with a simple HSL diagnosis of HAVS underwent further investigation. This may have been for medico-legal reasons but we have no information on this possibility.

Care has to be taken in interpreting the data on further medical assessment and confirmation of the HSL diagnosis, as the questionnaire collects information from the worker rather than from a definitive medical document. However, there continues to be considerable interest in the differential diagnosis of HAVS and CTS within an occupational health framework of a HAVS assessment. Therefore in the next section, the relationship between a presumptive diagnosis of CTS in this cohort and the reported outcome of a further specialist referral has been investigated.

### 3.5.11 What happened to those subjects who had a primary or additional diagnosis of presumptive CTS at HSL?

The presumptive diagnosis of CTS in the HAVS assessment at HSL relies on positive Phalen’s and Tinel’s tests, reported characteristic symptoms of night waking with hand pain or paraesthesia and a median distribution of neurosensory abnormality. These are exactly the same criteria that would be applied in an initial investigation for CTS in subjects not exposed to vibration. Diagnosis is usually confirmed by nerve conduction velocity (NCV) measurements.

As noted in table 8, thirty-one subjects within the cohort had a diagnosis, which included a presumptive diagnosis of CTS. Only 35% (11/31) were referred on for further specialised medical assessment. These further referrals were split roughly equally between a simple, presumptive diagnosis of CTS or HAVS with a presumptive diagnosis of CTS. Table 9 details the initial diagnosis at HSL involving CTS and the outcome after further specialised medical assessment in those who underwent such assessment.

Three subjects reported that they had undergone decompression surgery for CTS within the follow-up period; one reported no change in problems with their hands, while two reported improvements in their hands. All three appeared to be bilateral CTS cases.

A further six subjects reported diagnoses of CTS on further medical investigation. Two subjects noted that they had been told they were mild cases and not yet considered for surgery; one was treated with steroids for relief of symptoms and one case where investigation was still ongoing but CTS was suspected. Therefore of the 11 cases with a presumptive diagnosis of CTS at HSL who were referred on, the majority (73%) were subsequently diagnosed as CTS.

Six subjects positively identified that they had undergone nerve conduction tests. It is possible that others in the cohort failed to remember or identify that they has undergone NCV tests.
Table 9  Description of outcomes, nerve conduction tests (NCV) in the eleven subjects with a presumptive diagnosis of CTS at HSL who were further medically investigated.

<table>
<thead>
<tr>
<th>Diagnosis at HSL</th>
<th>Referral diagnosis</th>
<th>Questionnaire comment</th>
<th>NCV investigation reported in questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAVS +CTS</td>
<td>CTS</td>
<td>Bilateral; successful</td>
<td>not stated</td>
</tr>
<tr>
<td>CTS</td>
<td>CTS</td>
<td>Told may need operation if gets worse</td>
<td>Yes</td>
</tr>
<tr>
<td>HAVS +CTS</td>
<td>CTS</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>CTS</td>
<td>CTS</td>
<td>Not bad enough to operate</td>
<td>Yes</td>
</tr>
<tr>
<td>CTS</td>
<td>CTS</td>
<td>Bilateral; one operation already</td>
<td>Yes</td>
</tr>
<tr>
<td>HAVS +CTS</td>
<td>CTS</td>
<td>Mild in one hand; borderline in other hand</td>
<td>Yes</td>
</tr>
<tr>
<td>CTS</td>
<td>CTS</td>
<td>Bilateral; surgery</td>
<td>not stated</td>
</tr>
<tr>
<td>CTS</td>
<td>CTS + early VWF</td>
<td>Refused surgery, treated with steroids with relief of symptoms</td>
<td>Yes</td>
</tr>
<tr>
<td>CTS</td>
<td>CTS + early VWF</td>
<td>No further comment</td>
<td>not stated</td>
</tr>
<tr>
<td>HAVS+CTS</td>
<td>HAVS 2Sn</td>
<td></td>
<td>not stated</td>
</tr>
<tr>
<td>HAVS+CTS</td>
<td>Raynauds HAVS</td>
<td></td>
<td>not stated</td>
</tr>
</tbody>
</table>
3.5.12  **Reported new medical conditions during the follow-up period**

The cohort reported a number of new medical conditions during the follow-up period (table 10). The precipitation of new upper limb problems did not seem to be associated with the subjects perceived use of vibrating tools; 3/5 cases no longer used vibrating tools and 2/5 reported less exposure to vibration from tools.

**Table 10  New medical conditions reported during the follow-up period**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bells palsy</td>
<td>1</td>
</tr>
<tr>
<td>Upper limbs problems, including 2 reports of lateral epicondylitis</td>
<td>5</td>
</tr>
<tr>
<td>Lower limb problems</td>
<td>1</td>
</tr>
<tr>
<td>Vasculitis</td>
<td>1</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>3</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1</td>
</tr>
<tr>
<td>Allopecia</td>
<td>1</td>
</tr>
<tr>
<td>Carpal tunnel syndrome</td>
<td>1</td>
</tr>
<tr>
<td>Hearing problems, including one report of tinnitus</td>
<td>3</td>
</tr>
<tr>
<td>Heart problem</td>
<td>1</td>
</tr>
</tbody>
</table>
Main findings

- 96 follow-up questionnaires covering employment status and further medical investigations were collected from a cohort of workers assessed at HSL; the mean follow-up time was 2.3 years and all had been initially assessed from 2005 onwards.

- 63% of the cohort had a diagnosis at HSL involving HAVS, with or without a presumptive diagnosis of CTS. About 10% were considered to have only CTS, and the remaining 28% were distributed across 16 diagnostic categories including a range of upper limb disorders, pre-existing conditions or systemic problems (percentages rounded up, so do not equate to 100%).

- 83% of the cohort was still in employment. There was no evidence that severity of HAVS, presumptive diagnosis of CTS involvement or length of follow-up influenced whether an individual was employed or not at follow-up.

- 87% of those employed at follow-up were also in the ‘same job’.

- 6/10 who had changed jobs had been redeployed within their original firm, with 2/10 made redundant. Increased sensorineural and vascular SWS staging were significantly associated with job change in the follow-up period.

- Of those still doing the same job 73% reported less or no vibration exposure over the follow-up period. Vascular or sensorineural SWS staging did not appear to be significant drivers of perceived reduced vibration exposure.

- While more of the cohort perceived that problems in their hands had got worse rather than better during follow-up, this subjective assessment was not related to changes in employment, job or tool status, or severity of HAVS at assessment.

- 28% of the cohort assessed at HSL for HAVS had undergone further medical assessment. About a third of those involving a presumptive diagnosis at HSL were referred for further medical investigation.

- About a third of those diagnosed at HSL, which included a presumptive diagnosis of CTS, went on for further assessment. These were almost equally split between HAVS +CTS and CTS only cases.
3.6 DISCUSSION

This follow-up questionnaire study was carried out on almost every individual who was referred to the HAVS assessment centre at HSL between January 2005 and January 2009. The response rate was 34%. The individuals in the cohort were employed at a wide number of firms. Interestingly, while the largest group (19%) of subjects came from highway maintenance and utilities, as may be expected; the second largest group (16%) could be grouped as groundsmen, landscapers, gardeners and tree surgeons, reflecting a group of workers using a set of vibrating tools who have been increasingly referred to HSL.

We are cautious about transferring outcomes based on those individuals referred to HSL for HAVS assessment to the wider context of HAVS cases and the application of health surveillance. Also the outcomes are based on self-reporting, with some subjective opinion on changes over the follow-up period. However, there have been relatively few longitudinal studies of HAVS in Europe and none recently in the UK [7]. This represents one of the first longitudinal studies, albeit retrospective, that has investigated UK workers exposed to hand-arm vibration and covers a recent time-frame post 2005. While for 2 subjects the follow-up period was only 3 months or less; 90% of study cohort had follow-up periods between 9 months and 4.5 years, and where appropriate follow-up period was used as an explanatory variable in statistical analysis.

The data could be seen as having some encouraging outcomes in terms of the influence of health surveillance, maintaining employment/job status in those with some degree of HAVS and self-reported reductions in vibrating tool use.

Clearly, undergoing a tier 5 assessment or having a diagnosis of HAVS is not necessarily associated with a higher risk of unemployment. However, where there is evidence of a diagnosis of a more severe stage of HAVS, changes in jobs have been made, largely by redeployment within the company but with some redundancy in a minority of cases. Such changes would be expected if HAVS health surveillance is being acted upon. In those still doing the same job over the follow-up period, there was a substantial majority who considered that their vibration exposure had reduced (less time of tool use, using lower emission tools), or stopped. Those who reported their tool use had remained the same were at a lower classification stage of HAVS or were substantially without symptoms. This suggests that health surveillance outcomes are being acted upon and that there seems to have been a general decline in vibration exposure. Such outcomes may well reflect, HSEs significant activity over many years to improve health surveillance, and initiatives on both the supply chain for lower emission tools and controlling exposure.

However, there were significantly more subjects who reported that the problems with their hands had increased since the original assessment at HSL. This seems at odds with other data in a following chapter of this report about longitudinal disability scores and the general positive signs noted in the previous paragraph, but we have no other quantitative data in this cohort to substantiate this perception of changes in problems in the hands. Also, such problems may not be necessarily caused by vibration and by far the largest proportion of the cohort stated that their hand problems had stayed the same.

We were particularly interested in the outcomes of any further medical referrals in members of the cohort who have been given a presumptive diagnosis of CTS at the HSL HAVS assessment. The exact relationship between CTS and exposure to hand-arm vibration is still debated [8-10], although CTS from vibration exposure remains a prescribed disease (Department of Work and Pensions). Best practice in the differential diagnosis of CTS from sensorineural HAVS including a median nerve distribution also remains unclear, even though the management and
treatment of such cases may be different. Like many other HAVS assessments, HSL may give a presumptive diagnosis of CTS (with or without HAVS) based on positive signs of Phalen’s and Tinels’s tests, symptoms related to night waking with hand pain/paraesthesia and a clear median nerve distribution of neurosensory abnormality. However, the predictive value of Tinel’s and Phalen’s tests for CTS are not that powerful even for subjects without vibration exposure [11, 12], their predictive power in those exposed to vibration is unknown. Thus, it is possible that our criteria at HSL (and others) for a presumptive diagnosis of CTS may over-diagnose the extent of classical carpal tunnel compression. The gold standard for CTS diagnosis is abnormally slow nerve conduction velocity (NCV) measurements over the wrist. However, there is data to show that such measurements are to some extent slowed in HAVS cases or those exposed to vibration [13-15] which further complicates the differential diagnosis.

Ten of the cohort were given a presumptive, simple diagnosis of CTS at HSL. Six of these cases were reportedly followed up by further medical assessment (at least 4 subjects had NCV measurements taken) and the HSL diagnosis confirmed. It is unclear why the remaining 4 were not referred, but this data would suggest that the presumptive CTS diagnosis had been considered sound.

A further twenty-one of the cohort were given the more contentious diagnosis of HAVS plus presumptive CTS at HSL. Only five out of the twenty-one cases were sent for further clarification of their CTS involvement. In three cases the CTS involvement was confirmed, while in the other two cases HAVS was the remaining diagnosis. The size of these groups and the number not referred further mitigate against over interpreting the outcomes. However, it may suggest that differential diagnosis remains a real issue where an occupational physician with limited diagnostic tools must rely on the standard signs and symptoms.

It is noted that among the number of new medical conditions that were reported by the cohort during the follow-up period, two of the largest categories were upper limb problems (n=5) and hearing problems (n=3). However, the association between upper limb problems, ergonomic issues and the use of vibrating tools is not so widely understood [16]. For CTS the ergonomic issues surrounding wrist postures, repetitive movements as well as vibration exposure have been, and continues to be debated. However, we have no other comparative data on the incidence rate of upper limb problems in those workers who may continue to use vibrating tools and other manual workers.
PART 3: FOLLOW-UP OF SELF-REPORTED UPPER LIMB DISABILITY AND QUALITY OF LIFE IN INDIVIDUALS DIAGNOSED WITH HAND-ARM VIBRATION SYNDROME

4.1 AIM

To establish whether disability and quality of life has changed over a five and a half year period (2003-2009) and what factors are associated with this.

4.2 STUDY DESIGN

From September through to November 2003 a study investigating upper limb disability in HAVS was conducted [4, 17]. This involved 210 individuals who had attended the HSL for a HAVS assessment. The outcome from this HAVS assessment in terms of diagnosis and severity of disease were used in the present study. The individuals who returned the questionnaires in 2003 were sent a questionnaire in 2009 to obtain information regarding current health, employment status, DASH score and quality of life (QoL).

This study was approved by the HSE Research Ethics Committee (ETHCOM/REG/09/02).

4.3 QUESTIONNAIRE DESIGN

A questionnaire was designed for the study using a commercially available software package (Sphinx Survey v4.5) (Appendix 2). The first part of the questionnaire contained questions related to changes in health, smoking, employment status and vibration exposure over the follow-up period. The second part of the questionnaire contained the questions from the DASH questionnaire and the final part version 2 of the SF-36 Quality of Life questionnaire. Individuals were asked to complete the questionnaire and return it in the FREEPOST envelope provided. If individuals did not return the questionnaire within one month of mailing they were sent a second questionnaire as a reminder. If they still did not respond they were not contacted again.

For the initial study in 2003 the DASH and SF-36v2 questionnaires were used.

4.4 DATA ANALYSIS

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

The answers to the 30 questions from the DASH questionnaire (Appendix 2) were used to calculate the DASH score. Each question is given a score from 1 to 5 depending upon how difficult an individual feels that they find an activity. The total DASH score is then standardised to 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.
Calculation of Quality of Life (QoL) Scores

The QoL part of the questionnaire was scored, and missing values handled, according to the recommended method \[18\]. This leads to a standardized score on a 0-100 scale, with the higher scores relating to better Quality of Life. Aggregated scores for the two summary scales, the physical component scale (PCS) and the mental component scale (MCS), were derived using UK normal values \[1\] and normalised (mean=50, SD=10) according to the recommended procedure \[18\].

Statistical analysis

The influence of several factors (development of new medical conditions, vascular staging, sensorineural staging) on the mean raw DASH scores at initial or follow-up assessment were compared using one-way ANOVA and post-hoc tests with Bonferroni correction. Comparisons of mean DASH scores at initial and follow-up assessment were conducted using independent samples t-test. The mean DASH and QoL scores were compared to published normal values using a one-sample t-test.

Changes in the DASH and QoL scores over the follow-up period were calculated for each individual (Follow-up value – initial value). Factors that may explain these changes were explored using one-way ANOVA (sensorineural staging, vascular staging, self-reported health of hands, use of vibrating tools), independent samples t-test (current employment, diagnosis of CTS) and correlation (age). Mean changes in DASH and QoL scores were compared to zero using one-sample t-test.

4.5 RESULTS

4.5.1 Response rate and comparison of those who did/did not respond

From the 210 individuals who were included in the study in 2003 a total of 96 returned the follow-up questionnaires in 2009 (45.7%). The individuals who returned the questionnaires at follow-up were significantly older (p<0.0001) than the non-responders. The distribution of those falling into the four diagnostic groups related to HAVS and CTS were similar in those who responded and those who did not (p=0.198) (Table 11).

Table 11 Comparison of responders and non-responders

<table>
<thead>
<tr>
<th>Responded at follow-up</th>
<th>Age Mean (SD)</th>
<th>No HAVS/CTS Number (%)</th>
<th>HAVS only Number (%)</th>
<th>Both HAVS and CTS Number (%)</th>
<th>CTS only Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>54.8 (7.3)</td>
<td>5 (5.2)</td>
<td>57 (59.4)</td>
<td>31 (32.3)</td>
<td>3 (3.1)</td>
</tr>
<tr>
<td>No</td>
<td>49.6 (9.0)</td>
<td>11 (9.6)</td>
<td>61 (53.5)</td>
<td>32 (28.1)</td>
<td>10 (8.8)</td>
</tr>
</tbody>
</table>

Table 11 shows the age at follow-up and the initial diagnosis given by the physician in terms of HAVS and carpal tunnel syndrome (CTS) at the HSL HAVS assessment.
Four individuals at follow-up had more than three missing answers on the DASH questionnaire and consequently a DASH score could not be calculated. Therefore, in total there were 92 valid responses in the 2009 follow-up study.

The total number of individuals in the No HAVS/CTS and the CTS only groups were very small and thus any further analysis was restricted to the two groups with HAVS cases (HAVS only and HAVS with CTS). Overall, 84 valid responses were obtained from these two groups at follow-up. These constitute the cohort included in the remainder of this section of the report.

4.5.2 Characteristics of those included in the study

The average time between the completion of the first and second DASH questionnaires was 5.5 years with a range of 5.4 to 5.6 years for the 84 individuals diagnosed with HAVS and included in the study. The average time between completion of the second DASH questionnaire and the original HAVS assessment was 6.8 years (range 5.6 to 9.1 years).

The mean (SD) age of those included in the study was 54.8 (7.5) years. Sixty three % had been diagnosed with HAVS alone at initial assessment and 37% as having both HAVS and CTS. Around 60% of the group had been staged as having stage 2 sensorineural HAVS, and this was fairly equally split between the early and late stages (Figure 6). A further 35.7% had been diagnosed as stage 1Sn.

**Figure 6** Distribution of sensory staging in the 84 individuals with HAVS included in the study

A large proportion (39.3%) of the group had not been diagnosed with vascular HAVS (Figure 7). A further 48% of the group had been given a staging of either 2 or 3V on the Stockholm Workshop scales.
4.5.3 Absolute DASH score before and after follow-up

4.5.3.1 Influence of the development of new medical conditions

Of the 84 respondents with HAVS (with or without CTS) who completed the DASH questionnaire 30 reported that they had developed new medical conditions over the follow-up period and one individual had not completed the question. Ten of these reported developing problems in the upper limbs, and 20 of these reported developing a range of other problems including heart, respiratory and lower limb problems. The development of new medical conditions influenced the DASH score at follow-up with those reporting upper limb problems having a significantly greater (p=0.037) mean DASH score at follow-up than those who did not develop any new conditions (Figure 8). The mean DASH score at follow-up in those reporting other medical problems was slightly increased as compared to those with no new conditions but this was not statistically significant (p=0.626).

There was a tendency for the mean DASH score to increase at follow-up when compared to the initial DASH measurement in those developing upper limb disorders and those with other new medical conditions. However, these differences were not statistically significant (p=0.414 and p=0.703 respectively). In those who did not develop new medical conditions the mean DASH score was lower at follow-up but again this was not statistically significantly (p=0.2094). Overall, it appears that the development of new medical conditions affects the mean DASH score at follow-up. Therefore, as we were interested in changes in DASH score over time related to HAVS in the current study, subsequent analyses in the remainder of this section of the report focussed on those individuals who did not report any new medical conditions (n=53).
Figure 8  Relationship between the mean DASH score at initial and follow-up assessment and development of new self-reported medical conditions over the follow-up period

Each error bar shows the mean ± 2 SEM
4.5.3.2  **Influence of initial diagnosis and staging of disease**

The mean DASH score measured at the initial assessment was significantly greater in those who had both HAVS and CTS when compared to those with HAVS only (p=0.002) (Figure 9). This was also the case at follow-up (p=0.004). In both the diagnostic groups the mean DASH score at follow-up was lower than that measured at the initial assessment, but this was not statistically significant (p=0.4283 for HAVS and p=0.2637 for HAVS with CTS) (Figure 9).

**Figure 9**  Relationship between the mean DASH score at initial and follow-up assessment and initial diagnosis

Each error bar shows the mean ± 2 SEM
At either initial assessment or follow-up there was no effect of increasing severity of vascular disease on the mean DASH score (p=0.210 initial assessment and p=0.223 for follow-up) (Figure 10). There was a tendency for the mean DASH score at follow-up to be lower when compared to that measured at initial assessment, regardless of the vascular staging, but this was not statistically significant (lowest p=0.3314 for stage 0V).

**Figure 10** Relationship between the mean DASH score at initial and follow-up assessment and initial vascular staging

Each error bar shows the mean ± 2 SEM
Overall, the mean DASH score tended to increase with increasing severity of sensorineural HAVS for both the measurements at initial and follow-up assessment. However, this was not statistically significant (p=0.262 for initial and p=0.112 for follow-up assessment) (Figure 11). There was a tendency for the DASH score at follow-up to be lower than that at the initial assessment but this was not statistically significant at any sensorineural stage (lowest p=0.4060 for stage 1Sn).

Figure 11 Relationship between the mean DASH score at initial and follow-up assessment and initial sensorineural staging

Each error bar shows the mean ± 2 SEM

4.5.3.3 Comparison of measured DASH values to those published in normal controls and HAVS cases

The mean DASH scores for the group included in this study was compared to a published normal value of 10.1 from the United States of America [19] and a published value of 15.7 reported in German manual workers [20]. Both the value measured at initial assessment and follow-up were significantly higher than both of these reported normal values (p<0.001). The group in the present study was also compared to a recently published mean value of 42.2 in Canadian HAVS referrals [21]. In this case, the mean values measured at both assessments were significantly lower (p<0.0001) than that measured in the Canadian study.
4.5.4 Change in DASH score over the follow-up period

Figure 12 shows the distribution of the change in DASH scores (follow-up – initial assessment) over the follow-up period. The mean change in DASH score of $-4.49$ (SD 11.5) was significantly ($p=0.006$) lower than zero suggesting that on a group basis there was some improvement in DASH over the follow-up period. There was a large range in values with the majority of values lying within $\pm$ 10 points. However, there were some individuals who had either improved or got worse by as much as 30 points. There was no relationship between the change in DASH score and the time between completing the two DASH questionnaires ($p=0.702$).

The mean change in DASH score of $-4.49$ in the present study was compared to the reported variability in DASH score of 0.15 measured when individuals were tested and then re-tested over a 14 day period [22]. These changes in DASH score were significantly different ($p=0.0145$) supporting the idea that the change measured in the present study is larger than would be expected due to test-retest variability.

**Figure 12** Distribution of the change in DASH score over the follow-up period

In order to attempt to explain the changes in DASH over the follow-up period, the relationship between the change in DASH score and factors such as being currently employed, self-reported changes in vibration exposure, initial diagnosis and severity of disease, age and self-reported changes in the hands were explored.
4.5.4.1 Exploration of factors influencing the change in DASH over the follow-up period

Of the 53 individuals involved in the study 11 (20%) had become unemployed over the follow-up period. There was no significant difference in the mean change in DASH between those currently employed or unemployed (p=0.679) suggesting that the differences in DASH score could not be explained by current employment. In addition, there was no evidence that any of the other factors explored (initial diagnosis and severity of disease, additional diagnosis of CTS, age and self-reported changes in the hands) could explain any differences in the change in DASH score observed (Table 12).

Self-reported changes in vibration exposure were available for 48 out of the 54 HAVS cases included in the study. Overall, 44 out of the 48 individuals (92%) reported that their exposure had reduced (in terms of time or the use of lower vibration emission tools) or had stopped over the follow-up period. This means that only 4 individuals reported that their tool use had stayed the same. Consequently, it is difficult to explore the effect of no change in tool use, or reduction in vibration exposure on the change in DASH over the follow-up. When the mean changes in DASH for those who reported a reduction in exposure were compared to those reporting that they had stopped using vibrating tools there was no significant difference (p=0.899) (Figure 13). However for both these groups the mean changes in DASH score were significantly lower than zero (p=0.036 and p=0.049 respectively).

Figure 13 Relationship between the change in DASH score over the follow-up period and changes in self-reported vibration exposure

![Figure 13](image)

Each error bar shows the mean ± 2 SEM. The dashed line represents the line of zero difference, if there was no difference between initial and follow-up measurements.
Table 12 Analysis of potential explanatory variables for the change in DASH over the follow-up period

<table>
<thead>
<tr>
<th>Factor investigated</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current employment</td>
<td>0.679</td>
</tr>
<tr>
<td>Additional diagnosis of CTS as well as HAVS</td>
<td>0.675</td>
</tr>
<tr>
<td>Initial sensorineural staging</td>
<td>0.511</td>
</tr>
<tr>
<td>Initial vascular staging</td>
<td>0.911</td>
</tr>
<tr>
<td>Age</td>
<td>0.658</td>
</tr>
<tr>
<td>Change in self-reported health of hands</td>
<td>0.153</td>
</tr>
</tbody>
</table>
4.5.5 Measurement of Quality of Life

4.5.5.1 Absolute quality of life measurements before and after follow-up

The mean level for the physical component of QoL was generally lower in those with both HAVS and CTS, than with just HAVS alone i.e QoL was worse (Figure 14). This was statistically significant for the initial assessment in 2003 (p=0.005), but not for the follow-up assessment (p=0.160). The mean level for the physical component in either those with HAVS, or HAVS with CTS, were significantly lower than published normal United Kingdom values [1] at both initial and follow-up assessment (p<0.0001).

These differences with diagnostic group were not seen for the mental health component of QoL (Figure 15).

Figure 14 Relationship between the mean physical component QoL score at initial and follow-up assessment and initial diagnosis

Each error bar shows the mean ± 2 SEM
Figure 15  Relationship between the mean mental health component QoL score at initial and follow-up assessment and initial diagnosis

Each error bar shows the mean ± 2 SEM

4.5.5.2  Change in quality of life over the follow-up period

The mean change in the physical and mental health components of QoL over the follow-up period were −0.62 and 2.67 respectively. These differences were not statistically significantly different to zero (p=0.686 and p=0.102 respectively), suggesting that overall there was no change in QoL over the follow-up period. However, it was clear that some individuals had quite large changes in QoL (Figures 16 and 17). Therefore, factors that may potentially affect QoL were investigated (Table 13). It was not possible to identify any factor that could explain any of the differences in QoL over the follow-up period (Table 13).
**Figure 16** Distribution of the change in physical component of QoL score over the follow-up period

![Histogram for change in physical component](image1)

**Figure 17** Distribution of the change in mental health component of QoL score over the follow-up period

![Histogram for change in mental health component](image2)
Table 13 Analysis of potential explanatory variables for the change in QoL summary component measures over the follow-up period

<table>
<thead>
<tr>
<th>Factor investigated</th>
<th>Physical component</th>
<th>Mental Health component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current employment</td>
<td>0.334</td>
<td>0.816</td>
</tr>
<tr>
<td>Additional diagnosis of CTS as well as HAVS</td>
<td>0.196</td>
<td>0.739</td>
</tr>
<tr>
<td>Initial sensorineural staging</td>
<td>0.240</td>
<td>0.142</td>
</tr>
<tr>
<td>Initial vascular staging</td>
<td>0.243</td>
<td>0.356</td>
</tr>
<tr>
<td>Age</td>
<td>0.788</td>
<td>0.596</td>
</tr>
<tr>
<td>Change in self-reported health of hands</td>
<td>0.145</td>
<td>0.216</td>
</tr>
<tr>
<td>Change in use of vibrating tools*</td>
<td>0.198</td>
<td>0.433</td>
</tr>
</tbody>
</table>

* comparison of those reporting reduced tool exposure or that they had stopped using vibrating tools. Group reporting same tool use was too small (n=4)

4.5.5.3 Relationship between the change in DASH and QoL

There was a linear relationship between the measured change in DASH and the change in both the physical and mental health components of QoL ($r=-0.587$, $p<0.0001$ and $r=-0.320$, $p=0.023$ respectively) (Figures 18 and 19). As the DASH score increased on follow-up (i.e. the change was positive) the QoL fell (i.e. the change was negative). In other words, as disability increased the individuals self-reported quality of life reduced.
Figure 18  Relationship between the change in DASH score and the change in the physical component summary score over the follow-up period

![Graph showing the relationship between change in DASH score and change in physical component summary score.]

Figure 19  Relationship between the change in DASH score and the change in the mental health component summary score over the follow-up period

![Graph showing the relationship between change in DASH score and change in mental health component summary score.]


Main findings

- A good response rate of 46% was achieved in this 5.5 year follow-up study.

- Around 60% of those taking part had been given a staging of 2Sn (early) or greater, and around 50% a vascular staging of 2V or greater at their initial HAVS assessment.

- Development of new medical conditions, particularly upper limb problems, over the follow-up period affected the change in DASH score.

- As we found previously, the initial diagnosis (i.e. HAVS or HAVS and CTS) is an important determinant in the DASH score. The measured DASH scored in the group as a whole was significantly greater at initial assessment and follow-up than those published from the US general population data and German normal population data.

- Overall, on a group basis, the mean change in DASH score of around -4.5 points over the follow-up period was significantly less than zero, suggesting that disability had improved slightly over this period. This was not seen in the measures of quality of life.

- There was a wide range of changes in DASH and QoL score over the follow-up period, with some individuals showing very marked changes in either direction.

- Exploration of factors that may influence these changes did not identify any significant factor that could explain these wide changes.

- There was a good relationship between the changes in DASH and QoL, such that if the DASH fell the QoL increased.
4.6 DISCUSSION

There is a limited amount of information available in the literature regarding the long-term follow-up of individuals with hand-arm vibration syndrome, in terms of changes in their HAVS diagnosis [7]. Furthermore, the effect of vibration exposure and HAVS on the overall disability of individuals has not been studied to a great extent [4, 5, 23]. We have previously shown that individuals with HAVS have measured levels of disability that are abnormal when compared to a United States general population. In addition, the level of disability was related to the severity of disease (Stockholm Workshop Scale), particularly to the sensory component [4, 5].

The current study sought to follow-up the population that had previously taken part in a survey of upper limb disability in HAVS in 2003, some 5.5 years later, to establish if there had been any measurable changes in disability over this period. The study spanned the period in which the Control of Vibration at Work regulations had been implemented in the UK, but any changes in the population may not necessarily be attributable to this.

The study achieved a very good response rate with 96 of the original cohort of 210 returning the follow-up questionnaire (response rate 46%). There were no differences between those who responded and those who did not in terms of their original diagnosis, although the responders were on average slightly older. Overall, the population contained a large proportion of individuals more severely affected with HAVS with around 32% originally being diagnosed with stage 2Sn (late), 29% with 2Sn (early), 29% with stage 2V and 19% with stage 3V. However, the proportion with a vascular diagnosis of stage 1V or above was 60%, as compared to 96% with a diagnosis of stage 1Sn and above.

The DASH questionnaire has been used widely in several countries to investigate disability in disorders involving the upper limbs [24-30]. It has been thoroughly evaluated in terms of its reliability, validity and responsiveness [22, 25, 30-32]. Overall, it has been shown that this instrument responds to changes in the whole of the upper extremity and shows good validity, reliability and responsiveness [22]. Consequently, it is not unexpected that the DASH would have increased over the follow-up period in those individuals reporting the development of new medical conditions, particularly upper limb problems. The number of people reporting new medical conditions, and the range of problems reported, did not allow any further investigation of the responsiveness of the DASH questionnaire to different conditions. However, there were around 20 individuals in this group reporting the development of conditions other than upper limb disorders. This may suggest that changes in the DASH score can be influenced by changes in other parts of the body, and this has indeed been shown by one study in the literature [33]. Therefore, caution in attributing changes in the DASH score to the upper limbs may need to be exercised if other problems are also present e.g. lower limb disorders.

As the main aim of this study was to investigate changes in disability related to HAVS, those who reported the development of new medical conditions were excluded from the main analysis. Overall, it was found that at follow-up the DASH score was lower, with a mean change of −4.49 points. This suggests that, as a group, disability has improved over time. Clearly, this conclusion depends upon the reliability of the questionnaire on repeated occasions. There have been several studies that have looked at the test-retest reliability of the questionnaire, with the longest follow-up period being 14 days [22, 25, 30, 32]. It does not appear that there have been any studies that have looked at the reliability over a much more extended period. If it is assumed that the reliability would be similar over an extended period of years rather than days, then the studies report that the mean change in DASH score on repeated measurement vary between 0.9 and 0.15 DASH points [22, 25, 32]. Comparison of the mean change in the current study with the mean change of 0.15 reported in the study of Beaton et al
showed that these were significantly different (p=0.0145) supporting the idea that the change measured in the present study is a genuine change rather than simply a measure of repeatability. Furthermore, there was a large range in values of the change in DASH score, with some individuals seeming to get appreciably better and some worse. Beaton et al. have reported that the minimum detectable change at the 95% confidence level for an individual with the DASH questionnaire was 12.75 points. If this is applied to the data in the current study the majority of individuals (n=42) would have DASH scores between ±12.75 points, only 2 would have got worse (DASH score greater than 12.75), but 9 would have improved (DASH score less than 12.75). There were no specific factors that could be identified that determined whether an individual was better or worse according to this cut-off. However, it is of interest that one individual who improved had had two operations on his shoulder over the follow-up period and one individual who got worse had reported that he had undergone carpal tunnel decompression on both hands during the follow-up.

Overall, in terms of the absolute change in DASH score over the follow-up period it was not possible to identify any factor that significantly influenced the score, including the initial diagnosis and severity, age, employment status and self-reported exposure to vibration. However, it should be borne in mind that exploration of the effect of employment status and vibration exposure was limited in this study. It was not possible to collect full vibration histories from individuals, so we had to rely on self-reported perception of overall changes in vibration exposure. Also, because the majority of individuals were still in employment (80%), then statistically it was difficult to ascertain whether the employment status of an individual (employed versus unemployed) makes a difference to disability. As a result of these limitations, it is not possible to say definitively that changes in employment status and tool use do not affect the change in disability over time. Indeed, it is possible that the reduction in vibration exposure in the majority of individuals has driven the reduction in disability measured over the follow-up period. It is also possible that these changes are a consequence of an improvement in the severity of HAVS over this timeframe. There is evidence to suggest that HAVS, particularly the vascular component, may improve if vibration exposure is reduced. The sensory component, however, appears to be less reversible.

The findings of this study have also supported and reiterate the findings of our previous study conducted in 2003. In the previous study it was found that the DASH score was greater in those with an additional diagnosis of carpal tunnel syndrome and this has also been shown in the present study, both at initial assessment and follow-up. There was also a tendency for the DASH score at both initial assessment and follow-up to increase with increasing severity of the sensory component of HAVS. However this did not reach statistical significance unlike in the original 2003 study.

Whilst there appears to have been some improvement in the DASH score over the follow-up period the mean DASH score obtained before and after follow-up is still significantly greater than that reported for the US general population and that reported in German manual workers. In other words, individuals with HAVS have significantly greater disability than the general manual working population. There has only been one other study that has investigated disability in HAVS using the DASH questionnaire. This study included 139 Canadian workers with HAVS and found that the mean DASH score of 42.2 was significantly higher than that of the US general population. When compared to the mean DASH score obtained in the present study both the measurement obtained at initial assessment and follow-up were significantly lower than that reported by House et al. in their study. The reason for this difference between the studies is unclear. However, one potential difference was that those involved in the Canadian study generally had a greater severity of vascular HAVS as compared to the HSL study cohort (% 3V 48% versus 19%; % 0V 11% versus 39% in the Canadian and HSL studies respectively). They were generally less severe in terms of their sensory staging
(\%2Sn 25\% versus 60\%; \% 1Sn 66\% versus 35\% in the Canadian and HSL studies respectively).

In conclusion, the present study has shown that individuals with HAVS followed-up over an average period of 5.5 years show some improvement in disability. However, it has not been possible to identify the factors causing this change in the present study.
Dear recipient - Thank you for taking the time to complete this questionnaire.
You attended HSL for a Hand Arm Vibration Syndrome (HAVS) assessment on

The following questions relate to what has happened to you since then. Please complete them as well as you can.

Please mark your answers in the box relevant to you with a X

1. Following your HAVS assessment at HSL, were you told what the outcome was by your employer, company doctor/nurse or GP?
   - Yes
   - No
   - Don't know

2. Were you told that you have HAVS (also known as Vibration White Finger)?
   - Yes
   - No
   - Don't know

3a. Were you told that you may have something else?
   - Yes
   - No
   - Don't know

If YES, go to Question 3b. If NO go to Question 4a.

3b. If yes, what?
   - Carpal Tunnel Syndrome
   - Thoracic Outlet Syndrome
   - Other Please say what in box below

If other, please state

4a. Following your HAVS assessment, did you go for further medical investigations with specialist doctors or for further testing?
   - Yes
   - No
   - Don't know

If YES, go to Question 4b. If NO go to Question 5.

4b. If yes, what further investigations did you have?

4c. What was your final diagnosis?
5. In your opinion, how have the problems with your hands changed since your HAVS assessment at HSL?
   - [ ] My hands have not changed, they have stayed the same
   - [ ] My hands have improved
   - [ ] My hands have got worse

6. Since your HAVS assessment, what has happened to your smoking status?
   - [ ] I have remained a non-smoker
   - [ ] My smoking has remained the same
   - [ ] I have reduced the amount I smoke
   - [ ] I have increased the amount I smoke
   - [ ] I have stopped smoking

7. Have you got any other new medical problems since your HAVS assessment?

8. Are you currently in employment?
   - [ ] Yes
   - [ ] No

9a. Are you in the same job as you were when you attended HSL for your HAVS assessment?
   - [ ] Yes
   - [ ] No

9b. Following your HAVS assessment at HSL, what has happened to your use of vibrating tools in your job?
   - [ ] My tool use has stayed the same
   - [ ] My time using vibrating tools has reduced
   - [ ] I am using lower emission vibrating tools
   - [ ] I have stopped using vibrating tools

9c. Where your vibrating tool use has changed, do you feel this was as a result of your HAVS assessment?
   - [ ] Yes
   - [ ] No

10a. Why did your job change following your HAVS assessment?
   - [ ] I wished to change my job
   - [ ] I was redeployed to a different job in the same company
   - [ ] My company stopped my employment
   - [ ] I was made redundant
   - [ ] Other: Please say what in box below

10b. When did this happen? (please give an approximate date)

10c. Do you feel that your job changed because of your HAVS assessment?
   - [ ] Yes
   - [ ] No

If other, please state:

Please go to Question 12
11a. For what reason are you currently unemployed?  
☐ My company stopped my employment  
☐ I was made redundant  
☐ I retired due to my age  
☐ I retired because of ill-health  
☐ Other  Please say what in box below

If other, please state

11b. Do you feel that you became unemployed because of your HAVS assessment?  
☐ Yes  
☐ No

12. Do you have anything else you would like to tell us about what has happened to you since you had your HAVS assessment at HSL?

Thank you very much for taking the time to complete the questionnaire.

Please return the completed questionnaire in the FREEPOST envelope provided.
Dear recipient - Thank you for taking the time to complete this questionnaire. You attended HSL for a Hand Arm Vibration Syndrome (HAVS) assessment on ______/______/_____.

The following questions relate to what has happened to you since then. Please complete them as well as you can.

Please mark your answers in the box relevant to you with a "x".

1. Following your HAVS assessment at HSL, were you told what the outcome was by your employer, company doctor/nurse or GP? ☐ Yes ☐ No ☐ Don’t know

2. Were you told that you have HAVS (also known as Vibration White Finger)? ☐ Yes ☐ No ☐ Don’t know

3a. Were you told that you may have something else? ☐ Yes ☐ No ☐ Don’t know
   If YES, go to Question 3b. If NO go to Question 4a

3b. If yes, what?
   ☐ Carpal Tunnel Syndrome
   ☐ Thoracic Outlet Syndrome
   ☐ Other: Please say what in box below

   Further, please state

4a. Following your HAVS assessment, did you go for further medical investigations with specialist doctors or further testing?
   ☐ Yes
   ☐ No
   ☐ Don’t know
   If YES, go to Question 4b. If NO go to Question 5

4b. If yes, what further investigations did you have?

4c. What was your final diagnosis?
5. In your opinion, how have the problems with your hands changed since your HAVS assessment at HSL?  
- My hands have not changed, they have stayed the same
- My hands have improved
- My hands have got worse

6. Since your HAVS assessment, what has happened to your smoking status?  
- I have remained a non-smoker
- My smoking has remained the same
- I have reduced the amount I smoke
- I have increased the amount I smoke
- I have stopped smoking

7. Have you got any other new medical problems since your HAVS assessment?  

8. Are you currently in employment?  
- Yes
- No

9a. Are you in the same job as you were when you attended HSL for your HAVS assessment?  
- Yes
- No

9b. Following your HAVS assessment at HSL, what has happened to your use of vibrating tools in your job?  
You may choose more than one of the options if appropriate
- My tool use has stayed the same
- My time using vibrating tools has reduced
- I am using lower emission vibrating tools
- I have stopped using vibrating tools

9c. Where your vibrating tool use has changed, do you feel this was as a result of your HAVS assessment?  
- Yes
- No

10a. Why did your job change following your HAVS assessment?  
- I wished to change my job
- I was redeployed to a different job in the same company
- My company stopped my employment
- I was made redundant
- Other Please say what in box below

If other, please state

10b. When did this happen? (please give an approximate date)

10c. Do you feel that your job changed because of your HAVS assessment?  
- Yes
- No
11a. For what reason are you currently unemployed?

- My company stopped my employment
- I was made redundant
- I retired due to my age
- I retired because of ill-health
- Other: Please say what in box below

“Other, please state”

11b. Do you feel that you became unemployed because of your HAVS assessment?

- Yes
- No

12. Do you have anything else you would like to tell us about what has happened to you since you had your HAVS assessment at HSL?

Please say what in box below

Please turn the page for the next part of the questionnaire
This part of the questionnaire asks about your symptoms as well as your ability to perform everyday jobs or tasks.

Please answer every question based on your condition in the **LAST WEEK** by **PUTTING ACROSS** the appropriate box. If you did not have the opportunity to perform the activity in the past week, please make your best estimate on which response would be the most accurate.

It doesn’t matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Open a tight or new jar</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>14. Write</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>15. Turn a key</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>16. Prepare a meal</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>17. Push open a heavy door</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>18. Place an object on a shelf above your head</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>19. Do heavy household chores (e.g. wash walls, wash floors)</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>20. Garden or do yard work</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>21. Make a bed</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>22. Carry a shopping bag or briefcase</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>23. Carry a heavy object (over 10 lbs)</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>24. Change a light bulb overhead</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>25. Wash or blow dry your hair</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>26. Wash your back</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>27. Put on a pullover sweater</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>28. Use a knife to cut food</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>29. Recreational activities which require little effort (e.g. card playing, knitting, etc)</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>30. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis, etc)</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
<tr>
<td>31. Recreational activities in which you move your arm freely (e.g. playing frisbee, badminton, etc.)</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>Unable</td>
</tr>
</tbody>
</table>
32. Manage transportation needs (getting from one place to another)

<table>
<thead>
<tr>
<th>Difficulty Level</th>
<th>No difficulty</th>
<th>Mild difficulty</th>
<th>Moderate difficulty</th>
<th>Severe difficulty</th>
<th>Unable</th>
</tr>
</thead>
</table>

33. Sexual activities

<table>
<thead>
<tr>
<th>Difficulty Level</th>
<th>No difficulty</th>
<th>Mild difficulty</th>
<th>Moderate difficulty</th>
<th>Severe difficulty</th>
<th>Unable</th>
</tr>
</thead>
</table>

34. 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?

<table>
<thead>
<tr>
<th>Extent</th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
</table>

35. 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?

<table>
<thead>
<tr>
<th>Limitation</th>
<th>Not limited at all</th>
<th>Slightly limited</th>
<th>Moderately Limited</th>
<th>Very Limited</th>
<th>Unable</th>
</tr>
</thead>
</table>

Please rate the severity of the following symptoms in the last week

<table>
<thead>
<tr>
<th>Symptom</th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>36. Arm, shoulder or hand pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. Arm, shoulder or hand pain when you performed any specific activity</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
<td>Extreme</td>
</tr>
<tr>
<td>38. Tingling (pins and needles) in your arm, shoulder or hand</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
<td>Extreme</td>
</tr>
<tr>
<td>39. Weakness in your arm, shoulder or hand</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
<td>Extreme</td>
</tr>
<tr>
<td>40. Stiffness in your arm, shoulder or hand</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
<td>Extreme</td>
</tr>
<tr>
<td>41. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?</td>
<td>No difficulty</td>
<td>Mild difficulty</td>
<td>Moderate difficulty</td>
<td>Severe difficulty</td>
<td>So much difficulty that I can’t sleep</td>
</tr>
<tr>
<td>42. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neither agree nor disagree</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
<tr>
<td>43. In general, have you pain or problems with your neck?</td>
<td>Not at all</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Quite a bit</td>
<td>Extreme</td>
</tr>
<tr>
<td>44. In general, have you pain or problems with your shoulders?</td>
<td>Not at all</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Quite a bit</td>
<td>Extreme</td>
</tr>
<tr>
<td>45. In general, have you pain or problems with your arms?</td>
<td>Not at all</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Quite a bit</td>
<td>Extreme</td>
</tr>
<tr>
<td>46. In general, have you pain or problems with your hands or wrists?</td>
<td>Not at all</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Quite a bit</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

Please turn the page for the next part of the questionnaire
The following questions asks for your views about your health and how you feel about your overall health. If you are unsure about how to answer any question, try and think about the activities that you might do during a typical day. Do not spend too much time answering as your immediate response is likely to be most accurate. Please put a cross in one box on each line.

### Questions About Health

**47.** In general, would you say your health is:  
- Excellent  
- Very good  
- Good  
- Fair  
- Poor

**48.** Compared to one year ago, how would you rate your health in general now?  
- Much better than one year ago  
- Somewhat better than one year ago  
- About the same  
- Somewhat worse than one year ago  
- Much worse than one year ago

### Questions About Activities During a Typical Day

The following questions are about activities you might do during a typical day. Does it limit you in these activities? If so, how much?

- **49a.** Vigorous Activities, such as running, lifting heavy objects, participating in strenuous sports  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49b.** Moderate Activities, such as moving a table, pushing a vacuum, bowling or playing golf  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49c.** Lifting or carrying groceries  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49d.** Climbing Several flights of stairs  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49e.** Climbing One flight of stairs  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49f.** Bending, kneeling or stooping  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49g.** Walking More than a Mile  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49h.** Walking Half a Mile  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49i.** Walking 100 Yards  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

- **49j.** Bathing and dressing yourself  
  - Yes, limited a lot  
  - Yes, limited a little  
  - No, not limited at all

### Questions About Work or Other Regular Activities

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

- **50a.** Cut down on the amount of time you spend on work or other activities  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time

- **50b.** Accomplished less than you would like  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time

- **50c.** Were limited in the kind of work or other activities  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time

- **50d.** Had difficulty performing the work or other activities (eg, took more effort)  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time

### Questions About Emotional Problems

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

- **51a.** Cut down on the amount of time you spend on work or other activities  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time

- **51b.** Accomplished less than you would like  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time

- **51c.** Did work or other activities less carefully than usual  
  - All of the time  
  - Most of the time  
  - Some of the time  
  - A little of the time  
  - None of the time
52. During the PAST 4 WEEKS, to what extent have your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours or groups?

53. How much bodily pain have you had during the PAST 4 WEEKS?

54. During the PAST 4 WEEKS how much did pain interfere with your normal work (including work both outside the home and housework)?

These questions are about how you feel and how things have been with you DURING THE PAST 4 WEEKS. For each question, please give the one answer that comes closest to the way you have been feeling.

55a. Did you feel full of life?
55b. Have you been very nervous?
55c. Have you felt so down in the dumps that nothing could cheer you up?
55d. Did you have a lot of energy?
55e. Did you feel worn out?
55f. Have you been happy?
55g. Did you feel downhearted and low?
55h. Have you felt calm and peaceful?
55i. Did you feel tired?

56. During the PAST 4 WEEKS, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, going out, etc.)?

How True or False is each of the following statements for you?

57a. I seem to get ill more easily than other people
57b. I am as healthy as anybody I know
57c. I expect my health to get worse
57d. My health is excellent

Please check that you have answered all questions.

Thank you for taking the time to fill in the questionnaire.

Please return the completed questionnaire in the FREEPOST envelope provided.
6 REFERENCES


2. Poole, K. and H. Mason, Data mining in a HAVS referral population. CWH/07/01. 2007.


Gathering intelligence from referrals to HSL for hand-arm vibration syndrome

This report details three separate pieces of work, which are linked by the fact that they involve surveying individuals assessed for hand-arm vibration syndrome (HAVS) at the Health and Safety Laboratory (HSL), or the customers responsible for referring them. The first part of the work involved surveying customers who had referred individuals to HSL over the preceding year to obtain more information regarding the prevalence and incidence of HAVS in the workforces from which the referrals are drawn. The second part of the work surveyed individuals who had attended the HAVS centre since around the time of the implementation of the Control of Vibration at Work regulations (2005), to establish what had happened to them in terms of their employment status and medical referral. The final part constituted a longitudinal follow-up study of individuals who had previously taken part in a study investigating upper limb disability and quality of life in HAVS referrals in 2003. These individuals were surveyed again in 2009 (mean follow-up time 5.5 years), following the implementation of the new regulations, to establish if there had been any change in their disability or quality of life status.

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