The effect of hand–arm vibration syndrome on quality of life

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Introduction

Hand–arm vibration syndrome (HAVS) is a common occupational condition and therefore it is important to determine how it affects quality of life (QOL). We previously reported the results of a study of disability, assessed by the Disability of the Arm, Shoulder and Hand (DASH) [1] and the DASH Work Module [2] questionnaires in a group of workers with HAVS. However, QOL and disability are conceptually quite different, and therefore, we also administered the SF12 questionnaire to these workers to assess their physical and mental QOL and report the results here.

Methods

The study was approved by the Research Ethics Board of St. Michael’s Hospital, a teaching hospital affiliated with the University of Toronto. HAVS subjects recruited for
the study were assessed consecutively at our occupational medicine clinic over a 2-year period. A standardized clinical assessment was carried out to determine each subject’s Stockholm vascular [3] and sensorineural [4] stages, as well as the presence of carpal tunnel syndrome (CTS), confirmed by median neuropathy at the wrist in a nerve conduction test. The results on the more severely affected side were used in the analysis. Griffin and Bovenzi [5] have reported that the most common musculoskeletal problem associated with the use of vibratory tools is diffuse upper extremity pain. We therefore measured upper extremity pain using the Borg scale [6]. Pain was scored on a scale of 0–10 for the fingers, hands, wrists, forearms, elbows, shoulders and neck separately and an overall mean value was determined and then categorized into three groups: no or minimal pain (0–1), mild pain (>1–5) and severe pain (>5–10). The SF12 consists of 12 questions and allows measurement of separate physical (SF-P) and mental (SF-M) scales. The SF12 was completed on the same day as the clinical assessment but before any feedback was given about clinical findings. SAS 9.2 (SAS Institute, Cary, NC) was used for the statistical analysis. The SF12-P and SF12-M scores were compared with Canadian normative mean values [7] using a t-test after adjusting for age and sex. Separate multiple linear regressions were carried out for the SF12-P and SF12-M as the dependent variables. The independent variables in each model were the Stockholm vascular stage, the Stockholm sensorineural stage and the upper extremity pain score, which were considered the key HAVS-related predictor variables, as well as age and CTS, which were considered key potential confounders. An overall $R^2$ was calculated for each model and partial $R^2$ values were calculated for each of the independent variables in each model to determine the relative importance of each variable in predicting QOL.

**Results**

One hundred and forty-one subjects were recruited and 139 (99%) agreed to participate. They included 134 men and five women and their mean (SD) age was 48 (11) years. The numbers in the various Stockholm stages were as follows—vascular: stage 0 or 1: 25% (35), stage 2: 26% (36) and stage 3 or 4: 49% (68) and sensorineural: stage 0: 10% (14), stage 1: 66% (91) and stage 2 or 3: 25% (34). There were 18% (25) of subjects with upper extremity pain scores of 0–1, 56% (77) with scores >1–5 and 26% (35) with scores >5–10 with two missing pain score values. Forty-three per cent (59) were found to have CTS.

The mean (SD) values for the SF12-P and SF12-M were 36 (9) and 44 (12), respectively. There was missing information for one SF12 questionnaire, so that summary scores could not be calculated for one participant. The SF12-P was lower than the SF12-M ($P < 0.001$) and both the SF12-P and SF12-M were significantly lower than their corresponding Canadian population mean values after adjusting for age and sex ($P < 0.001$). The results of the multiple linear regression analysis are shown in Table 1 for the SF12-P and in Table 2 for the SF12-M. In both models, the highest partial $R^2$ was obtained for the pain score.

**Discussion**

We found the physical and mental QOL scores in HAVS subjects to be significantly below Canadian population normal values. The physical QOL was more affected than the mental QOL. The key predictor of reduced QOL for both physical and mental components was the upper extremity pain score. The Stockholm sensorineural scale, CTS and age were also found to be predictors of physical QOL but not of mental QOL.

The strengths of this study included its consecutive recruitment of subjects to minimize selection bias, a high participation rate, a reasonably large sample size and standardized clinical assessment. Its principal limitation was the fact that the subjects had been referred to our specialist clinic for assessment because of their HAVS symptoms, thus reducing generalizability.

The only other study that used a SF questionnaire to assess QOL in HAVS subjects found that both the

**Table 1. Multiple linear regression analysis with SF12-P as the dependent variable**

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Estimate (SE)</th>
<th>Partial $R^2$</th>
<th>Model $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockholm vascular stage</td>
<td>0.53 (0.78)</td>
<td>0.004</td>
<td>0.341</td>
</tr>
<tr>
<td>Stockholm sensorineural stage</td>
<td>-3.83 (1.14)*</td>
<td>0.081</td>
<td></td>
</tr>
<tr>
<td>Upper extremity pain score</td>
<td>-5.79 (0.99)**</td>
<td>0.209</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.25 (0.06)**</td>
<td>0.119</td>
<td></td>
</tr>
<tr>
<td>CTS</td>
<td>3.70 (1.32)*</td>
<td>0.058</td>
<td></td>
</tr>
</tbody>
</table>

The Stockholm vascular stage, Stockholm sensorineural stage, upper extremity pain score and age were analysed as continuous variables. CTS was analysed as a categorical variable (yes = 1, no = 0).

*P < 0.01; **P < 0.001; otherwise not statistically significant ($P > 0.05$).
Table 2. Multiple linear regression analysis with SF12-M as the dependent variable

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Estimate (SE)</th>
<th>Partial $R^2$</th>
<th>Model $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAVS-related predictors</td>
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<td>0.111</td>
</tr>
<tr>
<td>Stockholm vascular stage</td>
<td>$-1.02 (1.20)$</td>
<td>0.006</td>
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</tr>
<tr>
<td>Stockholm sensorineural stage</td>
<td>$-1.32 (1.75)$</td>
<td>0.004</td>
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<tr>
<td>Upper extremity pain score</td>
<td>$-4.55 (1.53)^*$</td>
<td>0.065</td>
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<tr>
<td>Confounders</td>
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<tr>
<td>Age</td>
<td>$-0.14 (0.09)$</td>
<td>0.018</td>
<td></td>
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<tr>
<td>CTS</td>
<td>$-1.72 (2.03)$</td>
<td>0.006</td>
<td></td>
</tr>
</tbody>
</table>

The Stockholm vascular stage, Stockholm sensorineural stage, upper extremity pain score, age and CTS were analysed as in Table 1.

*P < 0.01; otherwise not statistically significant (P > 0.05).

Physical and mental QOL components were below UK population normal values [8]. However, it did not examine the effect on QOL of upper extremity pain or any other musculoskeletal variable. A recent qualitative study by Ayers and Forshaw [9] found that HAVS subjects often complained of a lack of information on alternative pain control methods, relaxation techniques and stress management, suggesting that pain and psychological stress were important features of their experience of HAVS. These qualitative observations and our own study findings are consistent with current understanding of the general association between pain and diminished QOL. For example, Skevington [10] has reported that, when QOL was assessed using the World Health Organization Quality of Life (WHOQOL) questionnaire in patients selected from several major categories of illness, negative feelings affecting QOL were more closely related to reports of pain and discomfort than any other factor. Future research might focus on determining the types of medical services of most benefit in terms of minimizing pain and preventing loss of QOL in workers with HAVS.

In summary, this study has shown that workers with HAVS have reduced physical and mental QOL with upper extremity pain being the most important predictor of reduced QOL.

Funding
Research Advisory Council (grant number 01031), Workplace Safety and Insurance Board, Ontario, Canada.

Conflicts of interest
None declared.

References