

COMPENSATION OF HAND-ARM VIBRATION SYNDROME IN CANADA

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ABSTRACT

Objectives To provide an overview of the legislative landscape for hand-arm vibration syndrome (HAVS) in Canada, and to investigate HAVS compensation practices and trends in each of Canada's thirteen provinces and territories.

Methods The initial stage of this study reviewed existing legislation pertaining to hand-arm vibration in the Canadian provinces and territories. In the second stage of the study, Compensation Board policies in each jurisdiction were reviewed and the Compensation Boards were contacted to request information on adjudication criteria and recent claims data.

Results Only two of the thirteen provinces and territories have regulations addressing vibration exposure. There were 1190 identified claims accepted for HAVS in Canada in the six year period spanning 2003 to 2008 (average 198 claims per year). Considerable variation was found in assessment methods, adjudication policies, and the number of accepted claims for HAVS across jurisdictions.

Conclusions There exists a regulatory gap for HAV in Canada. Relative to prevalence estimates, the number of claims identified suggests under-recognition and under-reporting of HAVS in most Canadian jurisdictions. Compensation boards should refine their policies pertaining to HAVS case definition and adjudication criterion.

I. INTRODUCTION

Hand-arm vibration syndrome (HAVS) is an occupational disorder manifesting as vascular, neurological and musculoskeletal symptoms arising in the upper limb after exposure to hand-transmitted vibration.¹ HAVS has been a recognised occupational disease for over a century, with the first report of the condition published in Italy by Giovanni Loriga in 1911.² Alice Hamilton subsequently published a detailed report in 1918 identifying HAVS in limestone quarry workers in Bedford, Indiana.³ A follow-up study of workers at the same quarry in 1978 showed no appreciable change in the prevalence of HAVS (89% in 1918 vs. 80% in 1978).⁴ The findings of the 1978 follow-up study reflect the HAVS experience globally as the condition generally continues to be under-recognised despite remaining highly prevalent. The European Union is a notable exception as it has recently legislated occupational exposure limits for hand-arm vibration

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¹ B Noël, 'Pathophysiology and Classification of the Vibration White Finger' (2000) 73 *International Archives of Occupational and Environmental Health* 150.

² G Loriga, 'Il lavoro con i martelli pneumatici [Work with Pneumatic Drills]' (1911) 2 *Bollettino dell'Ispettorato del Lavoro* [Bulletin of the Labour Inspectorate] 35 [Google trans].

³ A Hamilton, 'A Study of Spastic Anemia in the Hands of Stonecutters: An Effect of the Air Hammer on the Hands of Stonecutters' (Industrial Accidents and Hygiene Series no 19, Bulletin no 236, United States Bureau of Labor Statistics, 1918).

⁴ W Taylor et al. 'Effect of the Air Hammer on the Hands of Stonecutters. The Limestone Quarries of Bedford, Indiana, Revisited' (1984) 41 *British Journal of Industrial Medicine* 289.

(HAV).⁵ From a compensation standpoint, the best known cohort of workers ever assessed for HAVS were miners evaluated by the direction of the Department of Trade and Industry in the United Kingdom;⁶ described as ‘the largest group of workers in the world claiming compensation for any single industrial disease’.⁷

Despite the recent legislative progress and compensation activity in Europe, prevalence estimates for HAVS remain poorly characterised. A Medical Research Council (MRC) postal survey in 1998 in the U.K. gave an estimate of 288,000 prevalent cases of HAVS in Great Britain.⁸ With respect to Canadian statistics, Patterson published a study reporting crude claims figures for HAVS in the years preceding 1984.⁹ The most comprehensive claims data at that time were from Ontario, with 1585 accepted claims for vibration white finger (HAVS) in the 64 years spanning 1920 and 1984. Claims data were not available from other provinces. A more recent report from Quebec suggested under recognition of HAVS in that province,¹⁰ though data are limited and there remains a paucity of information on this subject for Canada’s other provinces and territories. As an industrialised country demographically similar to the United Kingdom, but with a smaller population, one could postulate there to be perhaps 160,000 cases of HAVS in Canada. If the actual number of HAVS cases in Canada is even close to this estimate, the authors’ collective experience with HAVS in Canada’s three largest provinces (Ontario, Quebec and British Columbia) suggests that the condition is under recognised and under compensated.

This exploratory study was designed to investigate the number of accepted HAVS workers’ compensation claims in Canada; to investigate compensation practices for HAVS used by each provincial and territorial compensation board, and to provide an overview of the legislative landscape as it relates to HAVS in Canada’s thirteen provinces and territories. In doing so, the study aimed to identify gaps in the current legislative framework pertaining to HAVS and to describe the adjudication procedures for HAVS used by compensation boards in each jurisdiction.

II. STUDY DESIGN AND METHODS

The study was conducted in two stages. Stage 1 consisted of reviewing the existing legislation pertaining to HAV in the 10 provinces and 3 territories in Canada. This stage of the study involved a review of the occupational health and safety Acts and Regulations in each province and territory to determine what, if any, sections address vibration exposure in general and HAV exposure in particular. The compensation Acts and Regulations in each province were reviewed for sections relating to hand-transmitted vibration and the adjudication of claims for ‘hand-arm vibration syndrome’, ‘vibration white finger’ or other potentially related terms using the general search terms ‘vibration’ and ‘vascular’.

Stage 2 of the study consisted of directly contacting the Compensation Boards of each province or territory to request the following information: 1) whether HAVS was a compensable occupational disease in their jurisdiction, 2) the criteria, inclusive or exclusive, used for HAVS claims adjudication in their jurisdiction, and 3) the number of HAVS claims accepted for the most recent years available in their statistical records. Physician contacts at each Board were used in the initial request for information. Where physician contacts were not available, inquiry was made to an alternative contact as advised by the Board in question. In cases where a given board did not have a prescriptive policy with respect to entitlement criteria or diagnostic testing modalities, an

5 Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 On the Minimum Health and Safety Requirements Regarding the Exposure of Workers to the Risks Arising from Physical Agents (Vibration) (16th Individual Directive Within the Meaning of Article 16(1) of Directive 89/391/EEC) [2002] OJ L 177/13.

6 I J Lawson and K L McGeoch, ‘A Medical Assessment Process for a Large Volume of Medico-Legal Compensation Claims for Hand-Arm Vibration Syndrome’ (2003) 53 *Occupational Medicine* 302.

7 G Proud et al, ‘Cold Provocation Testing and Hand-Arm Vibration Syndrome – an Audit of the Results of the Department of Trade and Industry Scheme for the Evaluation of Miners’ (2003) 90 *British Journal of Surgery* 1076.

8 K T Palmer et al, ‘Hand-Transmitted Vibration: Occupational Exposures and Their Health Effects in Great Britain’ *Health and Safety Executive Contract Research Report 232/1999* (HSE Books, 1999) 35.

9 Craig Paterson, ‘Canadian Compensation Law and Vibration-Induced White Finger: A Revised Description’ (1986) 12 *Scandinavian Journal of Work, Environment and Health* 402.

10 Alice Turcot, Sophie Roy and André Simpson, *Lésions professionnelles reliées aux vibrations main-bras au Québec, 1993 à 2002 - Partie II: Analyse descriptive des dossiers d’indemnisation des travailleurs* [Injuries Related to Hand-Arm Vibration in Quebec from 1993 to 2001 – Part II: Descriptive Analysis of Records of Workers’ Compensation]. (Études et recherches / Rapport R-492 IRSST, 2007).

effort was made to speak directly with the physician(s) who conduct the HAVS assessments for the Board in question to further clarify the diagnostic approach.

The data were organised into summary charts for each province using the following headings: (A.) legislation, (B.) Board recognition of disease, (C.) entitlement criteria, (D.) testing modalities, (E.) claims data, and (F.) impairment rating. Claims data from each jurisdiction were combined to provide descriptive summary statistics for each province and for the country as a whole.

Ethics approval was not deemed necessary given that the study analysed data on a group level (no personal health information was collected) and the information reviewed for the policy and legislative portion of the study constituted publically available information.

III. RESULTS

Each of the ten provinces (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Quebec, and Saskatchewan) have their own Occupational Health and Safety Acts and their own Workers' Compensation Acts or equivalent, as does the Yukon territory. The Northwest Territories (NWT) and Nunavut are governed by the same workers' compensation Act and workers' compensation is administered by the same agency. As such, there are 12 Compensation Boards in Canada covering the 13 provinces and territories. Nine of the 12 Boards have Schedules and Regulations for occupational disease. Occupational diseases are not listed in Schedules or Regulations in the NWT & Nunavut, Prince Edward Island, or the Yukon. Of the 12 compensation boards across Canada, 11 responded to our request for information.

A. Legislation

Only two provinces, British Columbia and New Brunswick, have legislation specifically addressing exposure limits for hand-transmitted vibration. British Columbia legislation (BC Reg 296/97, Part 7, Division 2 – Vibration Exposure)¹¹ mandates occupational exposure limits for HAV to conform to the limits specified by the American Conference of Governmental Industrial Hygienists (ACGIH) *Threshold Limit Values and Biological Exposure Indices*.¹² New Brunswick vibration exposure legislation (O.C. 91-1035, General Regulation NB 91-191, Section 33.2 [Vibration]) also reflects the ACGIH threshold limit values (TLV), though the legislation does not reference the ACGIH specifically. The other provinces and territories could theoretically use their general duty clause to enforce the ACGIH TLV for HAV or other existing guidelines though, in the authors' experience, this provision has rarely, if ever, been used for this purpose. The only mention of vibration in Canadian federal legislation is with respect to whole body vibration (SOR/86-304, section 14.1). Canadian federal legislation does not address HAV in particular.¹³

B. Compensation Board Recognition of HAVS

All of the Canadian compensation board policies and/or Acts and Regulations acknowledge HAV related disease in some capacity with the exception of two: New Brunswick and Nova Scotia. New Brunswick Policy does address vibration in the context of cumulative trauma disorders and as a hazard under its defining of physical agents. Board recognition of HAVS, where present, is generally found in Board policy manuals and/or permanent impairment rating guides. Terminology varies by jurisdiction, with some jurisdictions referencing HAVS specifically, while others use such terms as 'whitehand vibration syndrome', 'white finger disease', 'vibration induced white finger', 'Raynaud's phenomenon [of occupational origin]' or cover the condition under the more general terms 'vibration induced diseases' or 'diseases caused by vibrations'. With respect to New Brunswick and Nova Scotia, lack of specification of the disease in official board documents does not necessarily mean that claims for HAVS are not recognised in these

¹¹ *Workers' Compensation Act, Occupational Health and Safety Regulation*, BC Reg 296/97.

¹² *ACGIH Annual Reports for the Year 2009: Committees on Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs)* (American Conference of Governmental Industrial Hygienists, 2009).

¹³ *Canada Occupational Health and Safety Regulations*, SOR/86-304, s.14.10

provinces. For example, claims were identified for HAVS in New Brunswick in the years preceding 2003 (though none were awarded in the study period spanning 2003-2008). In Nova Scotia, while no cases of HAVS per se were identified, claims were identified for other conditions that may have been HAVS but were classified as other conditions (for example, a claim was identified for ‘jack hammer neuritis and tendonitis’).

C. Entitlement Criteria

Initial entitlement criteria used in the adjudication of HAVS claims vary considerably by province (Table 1). In 6 of the 12 provinces and territories, duration of exposure is specified as requiring at least 2 years of exposure immediately preceding the onset of vascular disease. This exposure metric provides for a wide range of potential exposure durations because, depending on the job, 2 years of exposure could amount to between 500 hours or less (for workers using vibrating tools for less than 1 hour per day) to 2800 hours (for workers using vibrating tools up to 6 hours per day). Two jurisdictions, British Columbia and the NWT & Nunavut, specify a minimum number of hours of exposure required for initial entitlement criteria; at least 1000 hours in British Columbia and 3500 hours in the NWT & Nunavut. The other provinces and territories either do not specify initial entitlement criteria, or simply require confirmation by the assessing physician.

TABLE 1: Entitlement criteria used by compensation boards in the Canadian provinces and territories to determine the eligibility of a claim for hand-arm vibration syndrome for compensation

<i>Province/Territory</i>	<i>Initial Entitlement Criteria</i>
British Columbia	At least 1000 hours of exposure
Alberta	At least 2 years of exposure immediately preceding vascular disease
Saskatchewan	Not Specified
Manitoba	Not specified
Ontario	At least 2 years of exposure immediately preceding vascular disease
Québec	Not Specified
New Brunswick	Not Specified
Nova Scotia	Not Specified
Prince Edward Island	At least 2 years of exposure immediately preceding vascular disease
Newfoundland & Labrador	Not Specified
NWT & Nunavut	At least 3500 hours of exposure
Yukon	At least 2 years exposure immediately preceding vascular disease

D. Testing modalities

The testing modalities used for diagnosis and impairment rating for HAVS by province and territory are listed in Table 2. The most commonly used tests are Doppler examination of the upper extremities (four jurisdictions), plethysmography (four jurisdictions) and thermometry (three jurisdictions). Doppler assessment (used in British Columbia, Ontario, Quebec and NWT & Nunavut) is conducted to rule out large vessel disease, but is also done in conjunction with cold provocation in NWT & Nunavut to assess the presence of Raynaud’s phenomenon. In Ontario, Quebec and New Brunswick, Raynaud’s phenomenon is assessed using plethysmography pre-post cold provocation (indicates induction and severity of vasospasm). Plethysmography in British Columbia does not involve cold provocation. British Columbia, Ontario and Quebec also use thermometry with cold provocation to assess Raynaud’s phenomenon (measures recovery from vasospasm). With respect to the neurological component of HAVS, electromyography/nerve conduction studies are used in four provinces/territories (British Columbia, Ontario, Quebec and NWT & Nunavut), though Ontario is the only province where such testing is specifically prescribed by board policy. Testing for the musculoskeletal aspects of HAVS (using grip strength) is specified by two compensation boards in Canada: Ontario and the NWT & Nunavut.

TABLE 2: Testing modalities used for diagnosis and impairment rating determination of claims for hand-arm vibration syndrome in the Canadian provinces and Territories^a

Province/ Territory	Physician Diagnosis	Doppler (upper extremities)	Plethysmog- raphy	Thermom- etry	NCS/EM G	Current Perception Threshold	Grip Strength
British Columbia	X	X ^b	X ^{b,c}	X ^b	X ^b		
Alberta	X						
Saskatchewan	X						
Manitoba	X ^d						
Ontario		X	X	X	X ^e	X	X
Québec	X	X ^b	X	X	X		
New Brunswick			X ^b				
Nova Scotia							
Prince Edward Island	X						
Newfoundland & Labrador							
North West Territories & Nunavut		X ^f			X		X
Yukon	X						

^a Physician diagnosis is presumably required by all boards, but is only specifically addressed by board policy where listed.

^b Not prescribed by board policy but done at physician’s discretion.

^c Plethysmography testing in British Columbia does not involve cold-provocation

^d Impairment rating schedule requires evidence of arterial occlusion ‘as tested by either Allen’s test, digital pressures, or angiography’

^e Required if a specific claim of paresthesia is addressed

^f Doppler assessment at room temperature and with cold immersion; a positive response is interpreted as Raynaud’s phenomenon.

E. Impairment ratings

Workers’ compensation boards in Canada use either an internal impairment rating guide and/or the *American Medical Association Guides to the Evaluation of Permanent Impairment (AMA Guides)* for impairment rating determinations.¹⁴ One province (Alberta) uses an internal rating guide but defers to the most recent edition of the *AMA Guides* [currently the 6th edition] in cases where a given disease is not addressed by the internal guide. Of the three provinces that exclusively use the *AMA Guides*, the 4th edition is used by two provinces (Prince Edward Island and Nova Scotia), and the 3rd edition is used by one (Ontario). The Maximum impairment rating for HAVS was available for five provinces and territories: Alberta (50%), British Columbia (20%), Manitoba (50%), Ontario (79% upper extremities, 89% whole body [includes feet]), and the NWT & Nunavut (12%). Only one province, Ontario, includes vascular effects in the feet in its impairment rating determination.

F. Claims Data

Compensation boards in the ten provinces and three territories were asked to provide information about HAVS claims. The province of Newfoundland and Labrador was unable to identify specific HAVS claims based on their current record keeping methods. The NWT and Nunavut Workers’ Safety and Compensation Commission [WSCC] did not respond to our request for information.

¹⁴ R Rondinelli et al (eds), *Guides to the Evaluation of Permanent Impairment* (American Medical Association, 6th ed, 2007).

Claims data were available for 10 of the 12 Compensation Boards in Canada with the most recent summary data available for all jurisdictions being up to the year 2008 (Table 3). In the 6 year period 2003 to 2008 there were 1190 HAVS claims identified in Canada with the largest number of accepted claims being in Ontario (940) followed by Quebec (187) and British Columbia (39). There was an average of 198 accepted claims per year across the entire country, with 79% of these occurring in Ontario.

TABLE 3: Accepted claims for hand-arm vibration syndrome in the Canadian 2003 to 2008

<i>Province/Territory</i>	<i>Number of Accepted Claims for HAVS</i>
British Columbia	39
Alberta	8
Saskatchewan	5
Manitoba	9
Ontario	940
Québec	187
New Brunswick	1
Nova Scotia	0
Prince Edward Island	0
Yukon	1

Note:

1. Newfoundland and Labrador were unable to identify specific HAVS Claims based on current record keeping methods.
2. The North West Territories did not respond to our request for information.
3. Data keeping methods in New Brunswick may have resulted in claims being missed during the study period because statistics are generated by querying the system for a specific National Work Injury Statistics Program (NWISP) nature of injury code. A detailed validation review for the period 1992-2003 showed 11 claims (about 1 a year) for this period suggesting that the actual number of claims from 2003-2009 may have been ≈ 7 .
4. In Nova Scotia there were no accepted HAVS claims. There were 2 claims submitted for 'Raynaud's syndrome or phenomenon, vibration induced white finger disease' and 1 claim submitted for 'Raynaud's syndrome', though in all three the Raynaud's was deemed to be a pre-existing (personal) condition not arising during or from the course of employment. There were 8 carpal tunnel syndrome claims accepted for occupational vibration exposure, and 2 other claims accepted for 'finger numbness' and 'jack hammer neuritis and tendonitis'.

IV. DISCUSSION

The principal findings of this study were 1) prevention of HAVS has not been a legislative priority in Canada, 2) there is considerable variation across Canada in the assessment procedures and impairment rating methods used for HAVS by compensation boards, and 3) the number of accepted claims for HAVS in Canada appears to be low and varies considerably by jurisdiction with most claims being concentrated in a single province. While it is quite likely that similar disparities exist in other countries, especially those having de-centralised governance structures similar to Canada, the findings of this study are nonetheless intriguing in their identifying a legislative gap for HAVS in Canada and striking variations in compensation practices and number of awarded claims across jurisdictions. It should be noted that it is not necessary for a disease to be listed in legislation for the disease to be compensable in Canadian jurisdictions, so these data do not imply that some jurisdictions are failing to recognise the disease altogether, however lack of listing in legislation likely contributes to under recognition, under reporting, and lower likelihood of compensation of affected workers, thereby negatively impacting upon the compensation experience of individual claimants.

Canada is ahead of the United States but behind Europe with respect to legislation governing exposure to HAV. Legislated exposure limits for hand-transmitted vibration in Europe are outlined in EU Vibration Directive (2002/44/EC), which promulgates regulations for addressing exposure to hand-arm and whole body vibration in the workplace.¹⁵ In the United States, there is

¹⁵ See n5 above.

an American National Standards Institute (ANSI) standard addressing hand-arm vibration (ANSI S2.70),¹⁶ though ANSI's publications are not enforceable unless a government entity adopts them and, at present, the U.S. Occupational Safety and Health Administration (OSHA) has not adopted a HAV standard.¹⁷ In Canada, only two of the 13 provinces and territories have specified occupational exposure limits for HAVS. These limits reflect the current ACGIH TLV for hand-arm vibration, which is a commonly used approach to the setting of occupational exposure limits.

This study found the initial entitlement criteria used for HAVS adjudication to vary widely across the Canadian provinces and territories. Most common is the requirement of at least two years of exposure immediately preceding the onset of vascular disease, which may reflect data published by Miyashita et al who reported that, in forestry workers, symptoms of HAVS did not typically appear until after 2000 hours of exposure.¹⁸ Other studies have reported latencies between exposure and the development of HAVS to range from six weeks to over 14 years.¹⁹ British Columbia and the NWT & Nunavut specify the actual number of hours of exposure required; at least 1000 hours in British Columbia and 3500 hours in the NWT & Nunavut. Though defining the number of hours of exposure is more specific than number of years of exposure, neither method addresses the more important issue of exposure magnitude. Compensation boards should consider vibration magnitude as well as duration of exposure in making determinations for entitlement criteria because rigid criteria for number of hours of exposure may unjustly deny claimants with short durations of exposure to high intensity vibration while inappropriately considering claims for individuals with long durations of exposure to low intensity vibration.²⁰

The wide variation between Boards with respect to HAVS testing modalities reflects the complexity of HAVS diagnosis and the fact that there is currently no standardised assessment protocol used by any given country, jurisdiction or centre. The diagnosis of HAVS is complicated by involvement of three distinct systems (vascular, neurological and musculoskeletal) along with the fact that the differential diagnosis for each system outcome is broad. The occupational history (to confirm exposure) and past medical history (to rule out competing causes of presenting symptoms) remain the mainstay of diagnosis and this seems to be reflected by all boards in requiring physician diagnosis (though not necessarily specifying an occupational medicine specialist for this purpose). Objective verification of disease is of obvious importance in compensation settings and cold provocation tests are performed in at least four provinces and two territories. The neurological component of HAVS is explicitly recognised by four of the provinces/territories by their inclusion of electromyography (EMG)/nerve conduction studies (NCS) in the HAVS assessment process. Only one provincial Board's policy (Ontario) specifies objective neurological testing over and above EMG/NCS using aesthesiometer and vibration perception threshold tests (thereby considering the possibility of diffuse digital neuropathy). Attribution of musculoskeletal pathology to HAVS is difficult due to multiple concurrent ergonomic risk factors that exist in work that involves use of vibrating tools. That said, in rare instances where no co-morbid conditions exist (epicondylitis, carpal tunnel syndrome, significant osteoarthritis, hand pain, et cetera), grip strength using a dynamometer remains the primary test for musculoskeletal HAVS.²¹ The Purdue pegboard and other tests of manual dexterity may also be useful in disability determination. A majority of current Board policies tend not to address one

16 American National Standards Institute, *ANSI S2.70: Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand* (2006).

17 Donald E Wasserman, 'Manufacturing and the New ANSI S2.70-2006 Hand-Arm Vibration Exposure Standard' (2008) 18 *Human Factors and Ergonomics in Manufacturing* 658.

18 K Miyashita et al, 'Epidemiological Study of Vibration Syndrome in Response to Total Hand-Tool Operating Time' (1983) 40 *British Journal of Industrial Medicine* 92.

19 Bruce P Bernard (ed), *Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back* (US Department of Health and Human Services, 1997).

20 Ronnie Lundström, 'Effects of Local Vibration Transmitted from Ultrasonic Devices on Vibrotactile Perception in the Hands of Therapists' (1985) 28 *Ergonomics* 793; Y Tominaga, 'Dose-Response Relation for the Vibration Syndrome' in A J Brammer and W Taylor (eds) *Vibration Effects on the Hand and Arm in Industry* (John Wiley, 1982) 277.

21 Kenneth L McGeoch and W Harper Gilmour, (2000) 57 'Cross Sectional Study of a Workforce Exposed to Hand-Arm Vibration: With Objective Tests and the Stockholm Workshop Scales' *Occupational and Environmental Medicine* 35.

or more components of HAVS, so improved case definition and implementation of a standardised assessment protocol is recommended.

Impairment rating in compensation cases is closely tied to case definition and the judicious use of diagnostic tests. Comment on the appropriateness of impairment ratings used by workers' compensation boards in the provinces and territories is beyond the scope of this study, though it is noted that the most commonly used impairment rating guide is the *AMA Guides*. Maximum impairment ratings vary widely by province (from 12-89%), which may reflect the fact that not all components of HAVS are recognised by each jurisdiction's policies (e.g. musculoskeletal effects, or vascular effects in the feet).

The most pertinent finding of this study was the small number of accepted HAVS claims in Canada in relation to prevalence estimates using comparative statistics in Great Britain. The previously mentioned MRC 1998 postal survey determined a prevalence estimate of 288,000 cases of vascular HAVS (0.0005% of Britain's 57 million population at that time). The Health and Safety Executive in Great Britain previously compensated an average of 3000 or more cases of HAVS annually, a number that has now declined to an average of 1000 claims per year.²²⁻²³ As a demographically similar country with a population of about half the size, one could postulate that there to have approximately 160,000 cases of HAVS in Canada during the study period spanning 2003-2008. The fact there was only an average of 198 claims accepted per year suggests under recognition and/or under reporting of HAVS in Canada. The low number of accepted claims observed in this study is consistent with findings previously reported in Quebec,²⁴ and trends in occupational disease recognition and reporting in general.²⁵ In the case of HAVS, the degree of underreporting may be greater than other occupational diseases because it is not a widely known disease entity.

The large difference in concentration of claims by province (79% of all claims were in Ontario) may in part be explained by the fact that Ontario is the most populous province in Canada, followed by Quebec then British Columbia. However, the relative population size differences in each province are not large enough to account for the degree of differential claim numbers observed in the study. It may be that some provinces have a lower prevalence of occupational HAV exposure. However, the construction industry is present in every province so at least some cases would be expected even in jurisdictions where mining and forestry are not dominant industries. Perhaps the best explanation for the high number of accepted claims in Ontario is that it is the only province that has a university affiliated hospital based clinic dedicated to detailed clinical assessment of workers with HAVS thereby reflecting some degree of ascertainment bias.

The methodological strengths of this study include its broad consideration of legislation and compensation board policies across Canada. A limitation of this study was that not all compensation boards include HAVS as a specific diagnosis for statistical record keeping purposes, so it is possible that the study was affected by outcome misclassification resulting in underestimation of the actual number of HAVS related claims. That said, the number of misclassified HAVS claims would have to be significant to account for the degree of underreporting suggested by this study, and would not likely account for the large disparity in concentration of claims by province.

Future research should focus on two areas; 1) education and implementation of primary prevention at the level of governments (legislative/policy/implementation), employers and workers and 2) refinement of HAVS case definition to improve the HAVS adjudication process. Neither task is simple, with the implementation of primary prevention being the more challenging of the two. With respect to case definition, consideration of the diagnostics outlined in this paper could assist in better defining the assessment protocol, though testing modalities must continue to be updated as improved diagnostics are introduced and reported upon in the peer-reviewed literature.

22 KT Palmer et al, above n 8.

23 Health and Safety Executive, 'Hand Arm Vibration (HAV) in Great Britain'. Accessed on 7 November 2011. <<http://www.hse.gov.uk/statistics/causdis/vibration/index.htm>>.

24 Turcot et al, above n10.

25 J Paul Leigh and John A Robbins, 'Occupational Disease and Workers' Compensation: Coverage, Costs, and Consequences' (2004) 82 *Milbank Quarterly* 689.