Vibration Injury Network

Research Network on Detection and Prevention of Injuries due to Occupational Vibration Exposures

Guidelines for Whole-Body Vibration Health Surveillance

Appendix W1E to Final Report May 2001

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Abstract

There is strong epidemiological evidence that occupational exposure to WBV is associated with an increased risk of low back pain (LBP), sciatic pain, and degenerative changes in the spinal system, including lumbar intervertebral disc disorders. We present herein a prototype health surveillance scheme for WBV. Surveillance is the collection, analysis, and dissemination of data for the purpose of prevention. The aims are to assess health status and diagnose vibration-induced disorders at an early stage, to inform the workers on the potential risk associated with vibration exposure, to give preventive advice to employers and employees and to control whether preventive measures which have been taken, were successful. It is suggested that a pre-placement health examination should be offered to each worker who will be exposed to WBV so as to make the worker aware of the hazards, to obtain baseline health data, and to identify medical conditions that may increase the risk due to WBV. The case history should focus on personal history, work history, and leisure activities involving driving of vehicles. The personal medical history should detail back pain complaints, disorders in the spine, any injuries or surgery to the musculoskeletal system. A physical examination on the lower back should be performed on workers who have experienced LBP symptoms over the past 12 months. The pre-placement examination should be followed by periodic health re-assessment with a regular interval according to the legislation of the country. It is suggested that periodic medical examination should be made available at least every two years to all workers who are exposed to WBV. Any change in vibration exposure at the workplace should be reported by the employer. If an increase in vibration exposure or a change in health status have occurred, the medical re-examination should be offered at shorter intervals at the discretion of the attending physician. There should be a periodic medical examination, which includes recording any change in exposure to WBV. The findings for the individual should be compared with previous examinations. Group data should also be compiled periodically. Medical removal may be considered along with re-placement in working practices without exposure to WBV.

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1. BACKGROUND

1.1 CURRENT KNOWLEDGE ON WHOLE-BODY VIBRATION INJURIES

There is strong epidemiological evidence that occupational exposure to WBV is associated with an increased risk of low back pain (LBP), sciatic pain, and degenerative changes in the spinal system, including lumbar intervertebral disc disorders (Hulshof and Veldhuyzen van Zanten (1987), Burdorf and Sorock 1997, Bovenzi and Hulshof (1999), Hoogendoorn et al 1999, Lings and Leboeuf-Yde 2000). Owing to the cross-sectional design of the majority of the performed studies there is not yet sufficient data to outline a clear exposure-response relationship between WBV exposure and LBP disorders. Biodynamic and physiological experiments have shown that seated WBV exposure can affect the spine by mechanical overloading and excessive muscular fatigue supporting the epidemiological findings, supporting the possible causal role of WBV in the development of back trouble. Several data show that in particular the combination of prolonged sitting and exposure to WBV (which is often the case in vehicles) may increase the risk of spinal damage.

Exposure to WBV may also lead to neck-shoulder problems, digestive disorders, circulatory disorders, auditory effects, and reproductive effects as suggested in various studies in the literature. However, this association is less clear than that between WBV and LBP. In some European countries, such as Belgium, Germany, The Netherlands and France, certain disorders of the lumbar spine are under defined conditions recognised as an occupational disease.

1.2 PREVENTION MEASURES

On many workplaces, exposure to WBV is still not recognised as a serious problem and many occupational health and safety services have a lack of experience in prevention of adverse health effects. Different elements of prevention can be distinguished: technical prevention aimed at elimination or reduction of WBV at the source (e.g. suspension seats), organisational changes in the work, personal protection and medical prevention. In most cases only a combination of preventive actions will lead to a successful reduction in vibration exposure (Figure 1).

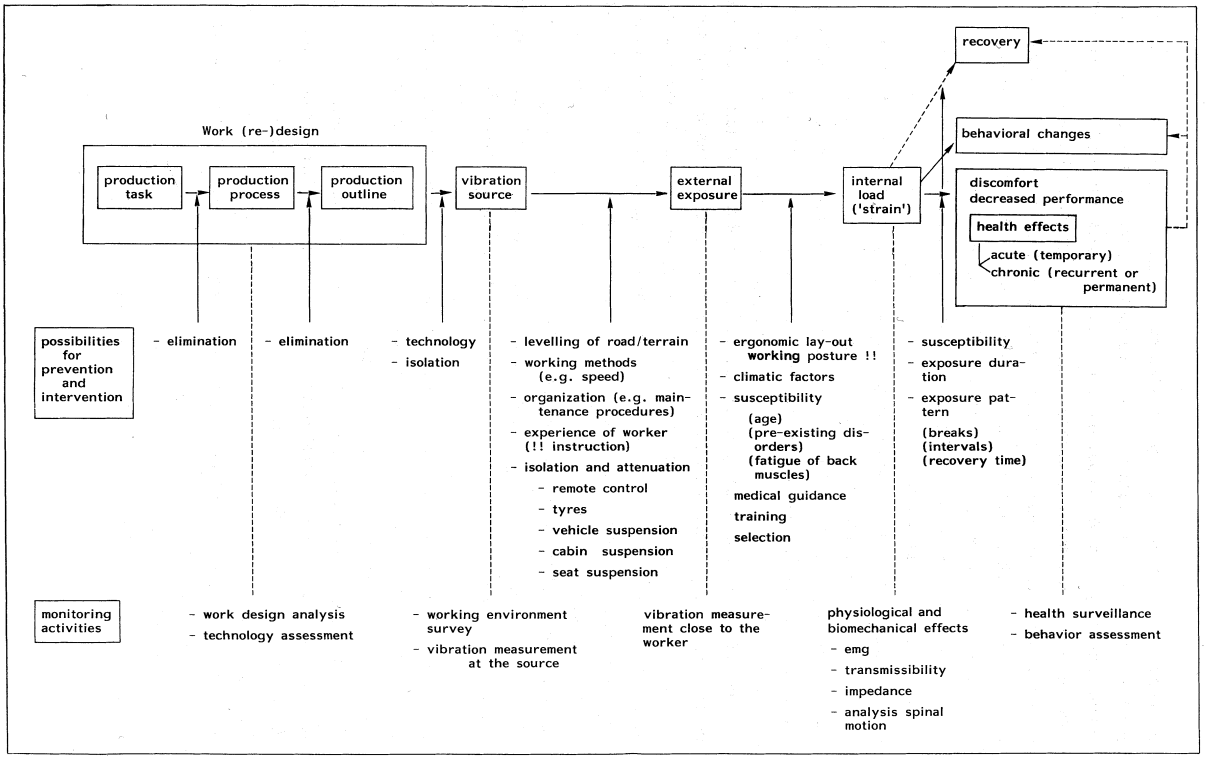

Figure 1. Model of sequence of preventive possibilities.

In addition to technical measures, like improvement of the ergonomic lay-out, in particular the forced working posture, and environmental factors, limitation of the vibration exposure duration and medical guidance are important tools for prevention. Appropriate information and advice to employers and employees and instruction in safe and correct work practices, in particular adopting optimal working posture and driving style and limitation of the driving speed, should be given. As personal protective equipment against WBV is not available, information, knowledge and tools enabling employees to cope with risk factors and early effects are basic in the maintenance of health and safety at the workplace.

2. OBJECTIVE

The EU Directive 89/391 requires that in member states measures are introduced to ensure that workers receive health surveillance appropriate to the health and safety risks they incur at work. The objective of this paper is to outline the development of guidelines and standard methods for health surveillance with respect to musculoskeletal disorders associated with WBV exposure.

2.1 HEALTH SURVEILLANCE BACKGROUND

Occupational *health surveillance in general* is defined as the ongoing systematic collection, analysis, interpretation, and the dissemination of data for the purpose of prevention (ILO 1997). The results of health surveillance should be used to protect and promote the health of the individual, collective health at the workplace, and the health of the exposed working population. It should lead to action. Furthermore, a workers' health surveillance programme must ensure: professional independence and impartiality of the health professionals, workers' privacy and confidentiality of individual health information. Fine (1999) explains the basics of two important uses of surveillance data: determining the magnitude of a specific occupational health or injury problem and examining temporal trends to determine whether the problem is increasing or decreasing. Increasingly, surveillance systems may be used to evaluate the effectiveness of interventions. Surveillance is most important in times of rapid change in the economy and when resources for prevention may be limited. Both conditions are common in the world today. Halperin (1996) reminds us that surveillance systems must be tailored to the specific disease or injury that is to be prevented. Surveillance should not be limited to the occurrence of death, disease, or disability. Public health is a multilevel cascade of activities involving recognition, evaluation, and intervention. Public health should include elements of experimentation as well as field implementation with evaluation. Surveillance is the mechanism to modify any element in the cascade based upon that element's contribution to prevention or lack thereof. Any element in the causal or intervention pathway is appropriate for surveillance as long as the monitoring of the element is useful in improving the prevention system. These elements include the occurrence of hazard and intervention as well as disease, death, or disability.

Froines et al (1986) suggest initially using national statistics. Davis (1976) suggests an occupational health audit as one way to get the job started. Sorock et al (1997) reviewed surveillance approaches for occupational injuries and evaluate three emerging methodologies for the enhancement of work-related injury surveillance: (1) narrative data analysis, (2) data set linkage, and (3) comprehensive company-wide surveillance systems. All three methods are the result of new applications of computer hardware and software that have apparent strengths and limitations. A major strength is the improved description of work exposures and related injuries leading to better understanding of injury aetiology. This understanding, however, is

limited by the data quality and completeness entered on records at the time of the injury. They recommend (1) more widespread inclusion of narrative text in databases, analyses of which can be a valuable supplement to injury coded data; (2) the increased use of data set linkage studies to combine injury and work-history data; and (3) the development of comprehensive company-wide surveillance systems to expedite the use of epidemiologic data for occupational injury prevention activities. Zielhuis and Henderson (1986) discuss the definitions of environmental monitoring (EM), biological monitoring (BM) and health surveillance (HS) as agreed upon by a CEC/NIOSH/OSHA-seminar in 1980. They emphasise the essential differences in underlying principles. They add a fourth definition of biological effect monitoring (BEM). Each method has its own assets and liabilities and are not necessarily applicable to WBV at this stage.

2.2 AIM OF HEALTH SURVEILLANCE ON WBV

The aims of *health surveillance with respect to whole-body vibration* are to assess health status and diagnose vibration-induced disorders at an early stage, to inform the workers on the potential risk associated with vibration exposure, to give preventive advice to employers and employees and to control whether preventive measures which have been taken, were successful. The employers should provide a health monitoring program for all workers occupationally exposed to whole-body vibration according to the legislation of the country. Appropriate facilities for the health surveillance of the vibration-exposed workers should be also provided by the employers. The management of a health surveillance program for workers exposed to whole-body vibration should be under the supervision of a physician with a speciality in occupational medicine or at least with a certified training in occupational health. Practical routine procedures for the application of the health surveillance program may be carried out by allied health professionals with experience in occupational health problems. The workers should be informed by the health care staff, that their personal and health data will be confidentially treated and preserved.

Pre-placement health assessment and periodic occupational health examinations at regular intervals should be conducted for each worker who is exposed to whole-body vibration at work. Furthermore, consultation of the occupational health physician by exposed workers who have symptoms or disorders, or who are otherwise concerned about their health shall be recommended.

3. HEALTH EXAMINATION

3.1 PRE-EMPLOYMENT HEALTH EXAMINATION

A pre-placement health examination should be offered to each worker who will be exposed to whole-body vibration at work. The main purposes of pre-placement health assessment are to make the worker aware of the hazards connected with exposure to whole-body vibration, to obtain baseline health data for comparison with the findings of subsequent periodical health examinations, and to verify the presence of pathological conditions which could represent possible medical conditions that may increase the risk of adverse effects due to WBV.

The pre-placement health evaluation must be performed according to the principles and practice of occupational medicine and to national legislation or guidelines with respect to pre-placement examinations. It will include a case history, a physical examination and, if necessary, special diagnostic investigations according to the clinical judgement of the physician (Appendix 1).

3.1.1 The case history

The case history should focus on:

- Social personal history including use of tobacco and alcohol and being involved in physical activities.
- The work history, with particular reference to past and current occupations with exposure to whole-body vibration; details about the types of vehicles used, the daily and total duration of exposure to whole-body vibration, the working posture, lifting tasks and other work-related back stressors. Leisure activities involving driving of vehicles causing exposure to whole-body vibration should be also investigated.
- The personal medical history, in particular with details of past and present acute or chronic back pain complaints, disorders in the spine, any injuries or surgery to the musculoskeletal system.

Note 1: Information on personal, social, work, and health histories may be obtained by means of a standardised questionnaire. The questions should be validated and the answers easy to be analysed. The use of clinical practical guidelines for LBP is recommended (Bigos et al. 1994).
As part of employee education and health surveillance the occupational health professional should provide information on the possible preventative measures to avoid or minimise the risk of adverse effects due to WBV.

3.1.2 The physical examination

A physical examination on the lower back should be performed on workers who have experienced LBP symptoms over the past 12 months. This physical examination includes:

- examination of the back function and evaluation of the effects on pain:
  - forward flexion
  - extension
  - lateral flexion
- straight leg raising test
- peripheral neurological examination:
  - knee and Achilles tendon reflexes
  - sensitivity in leg/foot
  - signs of muscle weakness (extension mm quadriceps, flexion/extension big toe/foot)
- back endurance test (tentative extra test)
- Waddell's signs of non-organic pain.

Note 2: Appendix IV provide a list of methods for physical examination of the lower back.

3.1.3 Additional investigation

In the absence of positive symptoms and signs and unless indicated by clinical practice guidelines, for the purpose of a pre-placement examination, it is in general not acceptable to perform further diagnostic clinical examinations like X-ray of the lumbar spinal column, CT-scan, myelography, or MRI.

Note 3: At the pre-placement examination, particular attention should be paid to any condition, which may aggravate the effects of exposure to WBV (e.g. poor posture, heavy and/or frequent lifting, tobacco use, and psycho-social factors). Appendix III reports a list of possible medical conditions that may increase the risk of disorders of the spine or other organs and structures in workers exposed to WBV.

3.2 PERIODIC HEALTH EXAMINATION

The pre-placement examination should be followed by periodic health re-assessment with a regular interval. The main purposes of the periodic health examination are the same as the ones of the pre-placement examination, to document the changes according to the baseline and to compile group data and report to management and employee representatives (in accordance with national legislation and practice of occupational medicine of the country). It is suggested that periodic medical examination should be made available at least every two years to all workers who are exposed to WBV. Any change in vibration exposure at the workplace should be

reported by the employer. If an increase in vibration exposure or a change in health status have occurred, the medical re-examination should be offered at shorter intervals at the discretion of the attending physician.

At the periodic medical examination, which should be conducted in the same way as described earlier, any change in work practices with the driving of vehicles or other sources of WBV should be reported in a follow-up questionnaire (Appendix II). Moreover, any illness or injury listed in Appendix III and which has occurred since the last examination, any symptom possibly related to vibration exposure as well as the findings of the physical examination should be also reported.

The reported findings for the individual should be compared with previous examinations. Group data should be compiled periodically and reported to management and representatives of employees.

3.3 MEDICAL REMOVAL

Avoidance or reduction of vibration exposure for workers affected with disorders possibly related to whole-body vibration and listed in Appendix III should be decided after considering the severity of symptoms, the characteristics of the entire working process, and other aspects related to the company's medical policy and the legislation of the country. Since there is clinical and epidemiological evidence that some of these disorders may be reversible when vibration exposure is ceased, the physician may discuss with the employee the possibility of his/her re-placement in working practices without exposure to WBV.

4. DISCUSSION

There is strong epidemiological evidence that occupational exposure to WBV is associated with an increased risk of low back pain (LBP), sciatic pain, and degenerative changes in the spinal system, including lumbar intervertebral disc disorders. Surveillance tells us what our problems are, how big they are, where the solutions should be directed, how well (or poorly) our solutions have worked, and if, over time, there is improvement or deterioration. Surveillance is essential to successful sustained public health intervention for the purposes of prevention. Further work needs to be done. A matter of discussion is whether occupational health surveillance should always cover both surveillance of workers'health and

surveillance of the working environment. Other discussions concern the comprehensiveness of the proposed questionnaires and the interval for health surveillance.

For example, German (2000) suggest that two important measurements for the evaluation of a public health surveillance system are sensitivity and predictive value positive (PVP). The computation of sensitivity and PVP for a public health surveillance system, however, can be complicated by the absence of an appropriate gold standard. Martin et al (1991) suggest another approach which could be considered in the future. This involves a computer-assisted elaboration of the job history (JH) for each worker by means of a job-exposure matrix (JEM) for each company. The final aim of the project is to find correlations between the exposure data of JHs and the health data of corresponding medical records. As a first experiment, some JEMs were computed using rectangular arrays even though it was realised that this simple structure was not really adequate. Later on, the structure of the computerised JEM included the following questions: (1) what types of information are involved; (2) how can the job-exposure correspondence be represented in the computer; (3) what characteristics of a company should be used for the elaboration of a JEM; (4) who is to construct each JEM, and how? This article shows the inadequacy of some occupational names for evoking the appropriate risks. A good health surveillance programme can be cost-effective. In another approach Holzner et al (1993) report one company's approach to collecting and managing exposure information through a Job Exposure Profile (JEP) system. The JEP system provides a concise and detailed summary of exposure information for defined exposure groups that can be tracked over time. Lukes (1998) provides an example of changes made to a medical/health surveillance program that resulted in cost savings while increasing services to employees. Further development of these methods and others is encouraged, especially in light of technological advancements in data capture, analysis and presentation. Only through such efforts can we best apply epidemiologic principles to preventing injuries in the workplace.

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Appendix I

Whole-body vibration: Pre-placement Health Surveillance Questionnaire

SECTION 1: Personal and general information

Name: _____ Surname: _____

Address: _____

_____

Post Code: |__|__|__|__|__|__|

day / month / year
Date of birth _____ Sex: M _____ F _____ Country of birth and raised _____

Height: _____ ft/m _____ in/cm Weight: _____ lbs./kg

Marital Status: Single |__| Married |__| Divorced/Separated |__| Widowed |__|

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1. Do you exercise regularly? Yes |__| No |__|
2. How often each week do you engage in any vigorous exercise program or work-out?

   Never |__| Less than 1 time |__| 1 to 2 times |__| 3 times or more |__| Everyday |__|
3. Do you smoke or chew tobacco or have you ever smoked? Yes |__| No |__|

3a. If yes, when did you start smoking regularly? 19____

3b. Do you still smoke? Yes |__| No |__|

3c. If no, when did you give up smoking? 19_____

3d. If yes, how much did you or do you smoke? _____

4. Do you drink alcoholic beverages? Yes |__| No |__| (wine, beer, etc.)

4a. How much do you drink weekly? |__| 1-3 glasses |__| 4-6 glasses |__| more than 6 glasses

4b. How much do you drink daily? |__| 0-1 glasses |__| 2-3 glasses |__| more than 3 glasses

5. Annual amount of personal car driving? (miles/km): |__| less than 5,000/8,000 |__|5 - 15,000/8 - 24,000

   |__|more than 15,000/24,000
6. How many school years have you completed? _____ years
7. What sports, if any, do you weekly participate in? _____

SECTION 2: Occupational history

Present Job (if any)

1. What is your current occupation? _____
2. In what industry (e.g. farming, shipyard, etc.) do you carry out this occupation? _____
3. How many years have you spent working in your present job? ____ Years
4. Did or do you drive any kind of vehicle in your current job? (i.e. car, bus, van, truck, train, tram helicopter, other)

   Yes |__| No |__|

If Yes: Type of vehicle	from – until	hours/day	days/week	weeks/year
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks

5. Which postures do you adopt when driving?

	Often	Occasionally	Never
bent forward	|__|	|__|	|__|
twisted	|__|	|__|	|__|
lean against backrest	|__|	|__|	|__|

6. Do you experience discomfort by mechanical vibration or shock in your work?

vertical vibration	Yes |__|	No |__|
fore/aft vibration	Yes |__|	No |__|
side-to-side vibration	Yes |__|	No |__|

7. How many hours a day do you spend sitting without vibration on the job? _____ hours
8. Does your job include manual lifting? Yes |__| No |__|

Up to 10lbs/5 kg |__|	10-20lbs/5-10kg |__|	More than 20lbs/10 kg |__|
times/day |__|	times/day |__|	times/day |__|

9. Does your job include (on an average working day) any of the following conditions?

   Prolonged or recurrent work done with your back:

bent forwards, backwards or sideways	Yes |__|	No |__|
twisted	Yes |__|	No |__|
bent and twisted simultaneously	Yes |__|	No |__|

10. Does your job include repeated, prolonged or uncomfortable carrying, pushing or pulling of loads? Yes |__| No |__|
11. Are there any other duties required in your job that stress your low back or neck?

    _____

    _____

Previous Job(s)

12. What was/were your previous occupation(s)?

_____ for_____years

_____ for_____years

_____ for_____years

13. Did you drive in your previous jobs on vehicles like: trucks, busses, fork lifts, earth moving equipment etc.? Yes |__| No |__|

If Yes: vehicle

_____ year(s) on a _____ on average _____ hours/day

_____ year(s) on a _____ on average _____ hours/day

_____ year(s) on a _____ on average _____ hours/day

_____ year(s) on a _____ on average _____ hours/day

_____ year(s) on a _____ on average _____ hours/day

_____ year(s) on a _____ on average _____ hours/day

14. Did your previous job(s) involve: prolonged sitting? Yes |__| No |__|

heavy physical demands? Yes |__| No |__|

15. Did you ever have low back pain in your previous job/s? Yes |__| No |__|

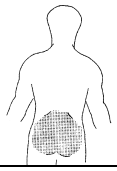
16. Did or do you drive on a regular basis any kind of vehicle in your spare time (outside work)? Yes |__| No |__|

If Yes: Type of vehicle	from – until	hours/day	days/week	weeks/year
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks

SECTION 3: Personal medical history

In this section, you will be asked about trouble you might have had in different parts of the body and at different time periods. **If you never have had any back pain/problem, ignore this section.**

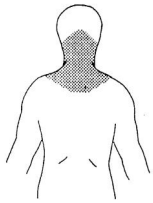
3.1: LOW BACK



	During the last 7 days		During last 12 months	
1. Did you have pain/ troubles	(a) never (b) seldom (c) often		(a) never (b) seldom (c) often	
2. What type of troubles did you have? (Circle all applicable alternatives)	(a) not applicable/no pain (b) back pain only (c) leg pain/symptoms only (d) back and leg pain/symptoms		(a) not applicable/no pain (b) back pain only (c) leg pain/symptoms only (d) back and leg pain/symptoms	
3. How many episodes have you had?	0 1 2-3 More than 4		0 1 2-5 6-10 more than 10	
4. How long did they typically last?	not applicable Hours 1-2 days Always		not applicable hours 1-2 days 3-6 days 2-4 weeks 1-3 months 3-6 months Always	
5. How much time did you have to take off work due to the back/leg pain?	None 1-2 days 3-4 days more than 5 days		None 1-4 weeks 1-3 months 3-6 months more than 6 months	
6. Has a doctor told you what was wrong with your back, i.e. given a diagnosis? *	No Yes	Namely	No Yes	Namely
7. Have you <u>ever</u> had a trauma to your back that required a medical visit?	No Yes	What kind of trauma?	When did it happen?	
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, other?)	None Yes	Namely	None Yes	Namely
9. Is there any movement or activity that causes your pain ?	No Yes	Namely	No Yes	Namely
10. Is there any movement or activity which aggravates your pain ?	No Yes	Namely	No Yes	Namely
11. Do you usually get back pain during or shortly after driving a vehicle ?	No Yes	Typically for how long?	No Yes	Typically for how long?

* i.e. disk herniation/protrusion, spinal stenosis, facet syndrome, spondylosis, spondylolisthesis, nerve root syndrome.

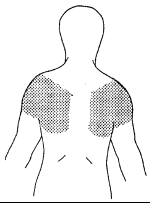
3.2: NECK
If you never have had any neck pain/problem, ignore this section.



	During the last 7 days		During last 12 months	
1. Did you have pain/ troubles	(a) never (b) seldom (c) often		(a) never (b) seldom (c) often	
2. What type of troubles did you have? (Circle all applicable alternatives)	(a) not applicable/no pain (b) neck pain only (c) arm pain/symptoms only (d) neck and arm pain/symptoms		(a) not applicable/no pain (b) neck pain only (c) arm pain/symptoms only (d) neck and arm pain/symptoms	
3. How many episodes have you had?	0 1 2-3 more than 4		0 1 2-5 6-10 more than 10	
4. How long did they typically last?	not applicable hours 1-2 days always		not applicable Hours 1-2 days 3-6 days 2-4 weeks 1-3 months 3-6 months Always	
5. How much time did you have to take off work due to the neck/arm pain?	None 1-2 days 3-4 days more than 5 days		None 1-4 weeks 1-3 months 3-6 months more than 6 months	
6. Has a doctor told you what was wrong with your neck, i.e. given a diagnosis? *	No Yes	Namely	No Yes	Namely
7. Have you ever had a trauma to your back that required a medical visit?	No Yes	What kind of trauma?	When did it happen?	
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, or other?)	None Yes	Namely	None Yes	Namely
9. Is there any movement or activity that causes your pain?	No Yes	Namely	No Yes	Namely
10. Is there any movement or activity, which aggravates your pain?	No Yes	Namely	No Yes	Namely
11. Do you usually get neck pain during or shortly after driving a vehicle?	No Yes	Typically for how long?	No Yes	Typically for how long?

* i.e. disk herniation/protrusion, nerve root syndrome, thoracic outlet syndrome.

3.3: SHOULDERS
If you never have had any shoulder pain/problem, ignore this.



	During the last 7 days		During last 12 months	
1. Did you have pain/ troubles	(a) never (b)seldom (c) often		(a) never (b) seldom (c) often	
2. What type of troubles did you have? (Circle all applicable alternatives)	(a) not applicable/no pain (b) shoulder pain only (c) arm/hand symptoms only (d) shoulder and arm pain/symptoms		(a) not applicable/no pain (b) shoulder pain only (c) arm/hand symptoms only (d) shoulder and arm pain/symptoms	
3. How many episodes have you had?	0 1 2-3 More than 4		0 1 2-5 6-10 more than 10	
4. How long did they typically last?	not applicable Hours 1-2 days Always		not applicable Hours 1-2 days 3-6 days 2-4 weeks 1-3 months 3-6 months Always	
5. How much time did you have to take off work due to the shoulder/arm pain?	None 1-2 days 3-4 days more than 5 days		None 1-4 weeks 1-3 months 3-6 months more than 6 months	
6. Has a doctor told you what was wrong with your shoulder, i.e. given a diagnosis?	No Yes	Namely	No Yes	Namely
7. Have you <u>ever</u> had a trauma to your shoulders that required a medical visit?	No Yes	What kind of trauma?	When did it happen?	
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, other?)	None Yes	Namely	None Yes	Namely
9. Is there any movement or activity that causes your pain ?	No Yes	Namely	No Yes	Namely
10. Is there any movement or activity which aggravates your pain ?	No Yes	Namely	No Yes	Namely
11. Do you usually get shoulder pain during or shortly after driving a vehicle ?	No Yes	Typically for how long ?	No Yes	Typically for how long?

3.4: Other parts of your body

Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:

Elbows

No Yes

|__| |__| in the right elbow

|__| in the left elbow

|__| in both elbows

Wrists/hands

No Yes

|__| |__| in the right wrist/hand

|__| in the left wrist/hand

|__| in both wrists/hands

Upper back

No Yes

|__| |__|

Hips/thighs/buttocks

No Yes

|__| |__| in the right hip

|__| in the left hip

|__| in both hips

Knees

No Yes

|__| |__| in the right knee

|__| in the left knee

|__| in both knees

Ankles/feet

No Yes

|__| |__| in the right ankle/foot

|__| in the left ankle/foot

|__| in both ankles/feet

3.5: Other disorders

Did you suffer from the following disorders?

	Ever had?		Ever been treated?	
Inguinal (groin) rupture (hernia)	Yes	No	Yes	No
Digestive disorders (aspecific stomach complaints, gastritis, stomach ulcer, intestinal complaints)	Yes	No	Yes	No
Circulatory problems (varicose veins, hemorrhoids, hypertension, heart complaints)	Yes	No	Yes	No
Raynaud's phenomenon, i.e. vibration white finger syndrome (white and/or cold fingers)	Yes No		Yes No	
Urinary disorders (prostatitis, renal disorder)	Yes	No	Yes	No
Vestibular disturbances (dizziness)	Yes	No	Yes	No
Female questions:				
How many pregnancies have you had?			Normal/abnormal?	
Have you ever had an involuntary abortion?	Yes	No		
Have you had menstrual irregulatories prior to exposure to vibration?	Yes	No		

3.6: Pain intensity and Disability (Only if you have not experienced any back, neck or shoulder pain during the past 12 months)

Pain intensity items

1. How would you rate your back/neck/shoulder pain on a 0-10 scale during the last 7 days where 0 is "no pain" and 10 is "pain as bad as it could be"?

	No pain										Pain as bad as it could be
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

2. In the past 12 months, how intense was your pain rated on a 0-10 scale where 0 is "no pain" and 10 is "pain as bad as it could be"?

	No pain										Pain as bad as it could be
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

Disability items

3. About how many days in the last 12 months have you been kept from your usual activities (work, school, or housework) because of:

Back pain	Number of days: 0	1– 6	7 – 14	15 – 30	31 +
Neck pain	Number of days: 0	1– 6	7 – 14	15 – 30	31 +
Shoulder pain	Number of days: 0	1– 6	7 – 14	15 – 30	31 +

4. In the past 12 months, how much has back/neck /shoulder pain changed your ability to work (including housework) where 0 is "no change" and 10 is "extreme change"?

	No change									Extreme	
	change										
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

5. In the past 12 months, how much has back/neck/shoulder pain changed your ability to take part in recreational, social, and family activities where 0 is "no change" and 10 is "extreme change"?

	No change									Extreme	
	change										
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

Appendix II

Whole-body vibration: Periodic Health Surveillance Questionnaire

SECTION 1: Personal and general information

Name: _____ Surname: _____

Address: _____

Post Code: |__|__|__|__|__|__|
day / month / year

Date of birth _____ Sex: M _____ F _____ Country of birth and raised _____

Height: _____ ft/m _____ in/cm Weight: _____ lbs./kg

Marital Status: Single |__| Married |__| Divorced/Separated |__| Widowed |__|

---

3. Do you exercise regularly? Yes |__| No |__|

4. How often each week do you engage in any vigorous exercise program or work-out?

Never |__| Less than 1 time |__| 1 to 2 times |__| 3 times or more |__| Everyday |__|

4. Do you smoke or chew tobacco or have you ever smoked? Yes |__| No |__|

3a. If yes, when did you start smoking regularly? 19____

3b. Do you still smoke? Yes |__| No |__|

3c. If no, when did you give up smoking? 19_____

3d. If yes, how much did you or do you smoke? _____

5. Do you drink alcoholic beverages? Yes |__| No |__| (wine, beer, etc.)

4a. How much do you drink weekly? |__| 1-3 glasses |__| 4-6 glasses |__| more than 6 glasses

4b. How much do you drink daily? |__| 0-1 glasses |__| 2-3 glasses |__| more than 3 glasses

5. Annual amount of personal car driving? (miles/km): less than 5,000/8,000 |__| 5-15,000/8-24,000 |__|
more than 15,000/24,000 |__|

6. How many school years have you completed? _____ years

7. What sports, if any, do you weekly participate in? _____

_____

SECTION 2: Work environment information

1. What is your present job? _____

2. How many years have you spent working in your present job? ____ Years

3. What kind of transportation do you use to get to and from work?

   Car |__| Bus |__| Train |__| Bicycle |__| Walk |__|

4. How long does it take you to get to work?

   Less than 20 min |__| 20-40 min |__| 40-60 min |__| More than 1 hour |__|

5. What kind of vehicles did and do you drive in your current job? (i.e. car, bus, van, truck, train, tram helicopter)

Type of vehicle	from – until	hours/day	days/week	weeks/year
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks
_____	19___ - 19___	___ hrs	___ days	____ weeks

6. On which type of ground surface do you drive regularly?

   asphalt/concrete:

good condition	|__| no	|__| yes	___ hours/day	_____ type of vehicle
poor condition	|__| no	|__| yes	___ hours/day	_____ type of vehicle
stelcon-plates:	|__| no	|__| yes	___ hours/day	_____ type of vehicle
paved road (cobbel)	|__| no	|__| yes	___ hours/day	_____ type of vehicle
track/rail	|__| no	|__| yes	___ hours/day	_____ type of vehicle
off-road	|__| no	|__| yes	___ hours/day	_____ type of vehicle
construction road	|__| no	|__| yes	___ hours/day	_____ type of vehicle
other, namely	|__| no	|__| yes	___ hours/day	_____ type of vehicle

7. In which environment do you usually drive?

	% time	vehicle
highway	_____	_____
country side road	_____	_____
city street	_____	_____
mixed	_____	_____

8. What is your normal style/speed of driving? Smooth |__| slow |__| fast |__| accelerating/braking |__|

9. On what kind of driver seat do you sit regularly?

   type _____ has suspension? Yes |__| No |__|

   Type of suspension?

   |__| mechanical suspension

   |__| air suspension

   |__| hydraulic suspension system

   Is your seat adjustable? yes |__| no |__|

   Do you adjust your seat? yes |__| no |__| not applicable |__|

   Did you receive instruction on how to adjust your seat? yes |__| no |__|_

   Do you use automatic or manual gear? Automatic |__| Manual |__|

10. Does your seat have a good back support? yes |__| no |__|

    Do you use a separate back support (belt) when you drive? yes |__| no |__|

    Does your seat have arm rests? yes |__| no |__|

    Do you use a arm rests when you drive? yes |__| no |__| not applicable |__|

11. Which postures do you adopt when driving?

	Often	Occasionally	Never
bent forward	|__|	|__|	|__|
twisted	|__|	|__|	|__|
lean against backrest	|__|	|__|	|__|

12. How often does your vehicle jerk or jolt so much that you are uplifted from your seat?

    |__| Never |__| Less than 5 times a day |__| More than 5 times a day, but less than 5 times an hour

    |__| More than 5 times an hour, but less than 5 times a minute |__| More than 5 times a minute

13. How often does your seat bottom out while you are driving?

    |__| Never

    |__| Less than 5 times a day

    |__| More than 5 times a day, but less than 5 times an hour

    |__| More than 5 times an hour, but less than 5 times a minute

    |__| More than 5 times a minute

14. Do you experience discomfort by mechanical vibration or shock in your work?

    vertical vibration yes |__| no |__|

    fore/aft vibration yes |__| no |__|

    side-to-side vibration yes |__| no |__|

15. How many hours a day do you spend sitting without vibration on the job? _____ hours

    How many days a week do you spend sitting? _____ days

    How many weeks a year do you spend sitting? _____ weeks

16. Do you have to maintain a twisted posture without vibration often and/or for prolonged times? yes |__| no |__|

17. How many hours on a typical day do you spend standing/walking on the job? _____ hours

    How many days a week do you work? _____ days

    How many weeks a year do you work? _____ weeks

18. Does your job include lifting? yes |__| no |__|

    Up to 10lbs/5 kg |__| 10-20lbs/5-10kg |__| More than 20lbs/10 kg |__|

    times/day|__| times/day |__| times/day |__|

19. Do you lift in awkward postures? (bent/twisted) yes |__| no |__|

20. If you drive and lift on the job how often do you lift immediately after driving?

    Seldom |__| Occasionally |__| Often |__|

    Does your job include (on an average working day) any of the following conditions?

    Prolonged or recurrent work done with your back:

    bent forwards, backwards or sideways Yes |__| No |__|

    twisted Yes |__| No |__|

    bent and twisted simultaneously Yes |__| No |__|

22. Does your job include repeated, prolonged or uncomfortable carrying, pushing or pulling of loads? Yes |__| No |__|

23. Are there any other duties required in your job that stress your low back or neck?

    _____

24. How many breaks do you usually take during the workday (this means getting out of your vehicle)? _____

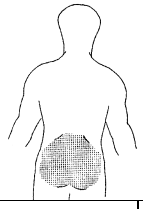
25. How long are your breaks? _____ minutes

26. What do you during your breaks? Walk around |__| Sit |__| Stand |__| Other |__|

SECTION 3: Personal medical history

In this section, you will be asked about trouble you might have had in different parts of the body and at different time periods. If you never have had any back pain/problem, ignore this section.

3.1: LOW BACK

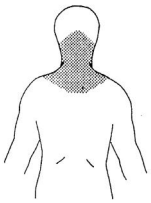


	During the last 7 days		During last 12 months	
1. Did you have pain/ troubles	(a) never| (b) seldom (c) often		(a) never (b) seldom (c) often	
2. What type of troubles did you have? (Circle all applicable alternatives)	(a) not applicable/no pain (b) back pain only (c) leg pain/symptoms only (d) back and leg pain/symptoms		(a) not applicable/no pain (b) back pain only (c) leg pain/symptoms only (d) back and leg pain/symptoms	
3. How many episodes have you had?	0 1 2-3 More than 4		0 1 2-5 6-10 more than 10	
4. How long did they typically last?	not applicable Hours 1-2 days Always		not applicable hours 1-2 days 3-6 days 2-4 wks 1-3 months 3-6 months Always	
5. How much time did you have to take off work due to the back/leg pain?	None 1-2 days 3-4 days more than 5 days		None 1-4 weeks 1-3 months 3-6 months more than 6 months	
6. Has a doctor told you what was wrong with your back, i.e. given a diagnosis? *	No Yes	Namely	No Yes	Namely
7. Have you ever had a trauma to your back that required a medical visit?	No Yes	What kind of trauma?	When did it happen?	
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, other?)	None Yes	Namely	None Yes	Namely
9. Is there any movement or activity that causes your pain ?	No Yes	Namely	No Yes	Namely
10. Is there any movement or activity which aggravates your pain ?	No Yes	Namely	No Yes	Namely
11. Do you usually get back pain during or shortly after driving a vehicle ?	No Yes	Typically for how long ?	No Yes	Typically for how long?

* i.e. disk herniation/protrusion, spinal stenosis, facet syndrome, spondylosis, spondylolisthesis, nerve root syndrome.

3.2: NECK

(If you never have had any neck pain/problem, ignore this section).

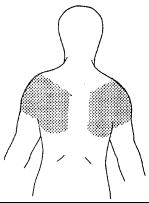


		During the last 7 days		During last 12 months	
1.	Did you have pain/ troubles	(a) never (b) seldom (c) often		(a) never (b) seldom (c) often	
2.	What type of troubles did you have? (Circle all applicable alternatives)	(a) not applicable/no pain (b) neck pain only (c) arm pain/symptoms only (d) neck and arm pain/symptoms		(a) not applicable/no pain (b) neck pain only (c) arm pain/symptoms only (d) neck and arm pain/symptoms	
3.	How many episodes have you had?	0 1 2-3 more than 4		0 1 2-5 6-10 more than 10	
4.	How long did they typically last?	not applicable hours 1-2 days always		not applicable Hours 1-2 days 3-6 days 2-4 weeks 1-3 months 3-6 months Always	
5.	How much time did you have to take off work due to the neck/arm pain?	None 1-2 days 3-4 days more than 5 days		None 1-4 weeks 1-3 months 3-6 months more than 6 months	
6.	Has a doctor told you what was wrong with your neck, i.e. given a diagnosis? *	No Yes	Namely	No Yes	Namely
7.	Have you ever had a trauma to your back that required a medical visit?	No Yes	What kind of trauma?	When did it happen?	
8.	What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, or other?)	None Yes	Namely	None Yes	Namely
9.	Is there any movement or activity that causes your pain?	No Yes	Namely	No Yes	Namely
10.	Is there any movement or activity, which aggravates your pain?	No Yes	Namely	No Yes	Namely
11.	Do you usually get neck pain during or shortly after driving a vehicle?	No Yes	Typically for how long?	No Yes	Typically for how long?

* i.e. disk herniation/protrusion, nerve root syndrome, thoracic outlet syndrome.

3.3: SHOULDERS

(If you never have had any shoulder pain/problem, ignore this section).



	During the last 7 days		During last 12 months	
1. Did you have pain/ troubles	(a) never (b)seldom (c) often		(a) never (b) seldom (c) often	
2. What type of troubles did you have? (Circle all applicable alternatives)	(a) not applicable/no pain (b) shoulder pain only (c) arm/hand symptoms only (d) shoulder and arm pain/symptoms		(a) not applicable/no pain (b) shoulder pain only (c) arm/hand symptoms only (d) shoulder and arm pain/symptoms	
3. How many episodes have you had?	0 1 2-3 More than 4		0 1 2-5 6-10 more than 10	
4. How long did they typically last?	not applicable Hours 1-2 days Always		not applicable Hours 1-2 days 3-6 days 2-4 weeks 1-3 months 3-6 months Always	
5. How much time did you have to take off work due to the shoulder/arm pain?	None 1-2 days 3-4 days more than 5 days		None 1-4 weeks 1-3 months 3-6 months more than 6 months	
6. Has a doctor told you what was wrong with your shoulder, i.e. given a diagnosis?	No Yes	Namely	No Yes	Namely
7. Have you <u>ever</u> had a trauma to your shoulders that required a medical visit?	No Yes	What kind of trauma?	When did it happen?	
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, other?)	None Yes	Namely	None Yes	Namely
9. Is there any movement or activity that causes your pain ?	No Yes	Namely	No Yes	Namely
10. Is there any movement or activity which aggravates your pain ?	No Yes	Namely	No Yes	Namely
11. Do you usually get shoulder pain during or shortly after driving a vehicle ?	No Yes	Typically for how long ?	No Yes	Typically for how long?

3.4: Other parts of your body

Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:

Elbows

No Yes

|__| |__| in the right elbow

|__| in the left elbow

|__| in both elbows

Wrists

No Yes

|__| |__| in the right wrist/hand

|__| in the left wrist/hand

|__| in both wrists/hands

Upper back

No Yes

|__| |__|

Hips/thighs/buttocks

No Yes

|__| |__| in the right hip

|__| in the left hip

|__| in both hips

Knees

No Yes

|__| |__| in the right knee

|__| in the left knee

|__| in both knees

Ankles/feet

No Yes

|__| |__| in the right ankle/foot

|__|in the left ankle/foot

|__| in both ankles/feet

3.5: Other disorders

Did you suffer from the following disorders?

	Ever had?		Ever been treated?	
Inguinal (groin) rupture (hernia)	Yes	No	Yes	No
Digestive disorders (aspecific stomach complaints, gastritis, stomach ulcer, intestinal complaints)	Yes	No	Yes	No
Circulatory problems (varicose veins, haemorrhoids, hypertension, heart complaints)	Yes	No	Yes	No
Raynaud's phenomenon, i.e. vibration white finger syndrome (white and/or cold fingers)	Yes		Yes	
	No		No	
Urinary disorders (prostatitis, renal disorder)	Yes	No	Yes	No
Vestibular disturbances (dizziness)	Yes	No	Yes	No
Female questions:				
How many pregnancies have you had?			Normal/abnormal?	
Have you ever had an involuntary abortion?	Yes	No		
Have you had menstrual irregulatories prior to exposure to vibration?	Yes	No		

3.6: Pain intensity and Disability

(Only if you have not experienced any back, neck or shoulder pain during the past 12 months)

Pain intensity items

2. How would you rate your back/neck/shoulder pain on a 0-10 scale during the last 7 days where 0 is “no pain” and 10 is “pain as bad as it could be”?

	No pain										Pain as bad as it could be
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

3. In the past 12 months, how intense was your pain rated on a 0-10 scale where 0 is “no pain” and 10 is “pain as bad as it could be”?

	No pain										Pain as bad as it could be
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

Disability items

4. About how many days in the last 12 months have you been kept from your usual activities (work, school, or housework) because of:

Back pain?	Number of days: 0	1– 6	7 – 14	15 – 30	31 +
Neck pain?	Number of days: 0	1– 6	7 – 14	15 – 30	31 +
Shoulder pain?	Number of days: 0	1– 6	7 – 14	15 – 30	31 +

4. In the past 12 months, how much has back/neck /shoulder pain changed your ability to work (including housework) where 0 is “no change” and 10 is “extreme change”?

	No change									Extreme change	
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

5. In the past 12 months, how much has back/neck/shoulder pain changed your ability to take part in recreational, social, and family activities where 0 is “no change” and 10 is “extreme change”?

	No change									Extreme change	
Back	0	1	2	3	4	5	6	7	8	9	10
Neck	0	1	2	3	4	5	6	7	8	9	10
Shoulder	0	1	2	3	4	5	6	7	8	9	10

3.7: Roland and Morris Disability Questionnaire

These questions are about the way your pain is affecting your daily life. We would like to know if you are currently in any of the situations listed below.
(If you have not suffered specifically from back pain during the past 12 months go straight to section 4)

Today, are you in any of the following situations?

1.	I stay at home most of the time because of my back.	yes	no	
2.	I change position frequently to try and get my back comfortable.		yes	
		no		
3.	I walk more slowly than usual because of my back.	yes	no	
4.	Because of my back I am not doing any of the jobs that I usually do around the house.	yes	no	
5.	Because of my back, I use a handrail to get upstairs.	yes	no	
6.	Because of my back, I lie down to rest more often.		yes	
7.	Because of my back, I have to hold on to something to get out of an easy chair.	yes	no	
8.	Because of my back, I try to get other people to do things for me.		yes	
		no		
9.	I get dressed more slowly than usual because of my back.		yes	
		no		
10.	I only stand up for short periods of time because of my back.		yes	
		no		
11.	Because of my back, I try not to bend or kneel down.	yes	no	
12.	I find it difficult to turn over in bed because of my back		yes	no
13.	My back is painful almost all the time.	yes	no	
14.	I find it difficult to get out of a chair because of my back.	yes	no	
15.	My appetite is not very good because of my back pain.		yes	
		no		
16.	I have trouble putting on my socks (or stockings) because of the pain in my back.	yes	no	
17.	I only walk short distances because of my back pain.	yes	no	
18.	I sleep less well because of my back pain.	yes	no	
19.	Because of my back pain, I get dressed with help from someone else.	yes	no	
20.	I sit down for most of the day because of my back.	yes	no	
21.	I avoid heavy jobs around the house because of my back.	yes	no	
22.	Because of my back pain, I am more irritable and bad tempered with people than usual.	yes	no	
23.	Because of my back pain, I go upstairs more slowly than usual.		yes	
24.	I stay in bed most of the time because of my back.	yes	no	

3.8: LBP Disability FABQ

What effect did or still does activity and work have on your back pain?

Please answer ALL statements and indicate whether you agree or disagree with each statement by circling the appropriate number on the scale ranging from 1 'Completely disagree' to 5 'Completely agree'.

	ACTIVITY AND BACK PAIN	**Disagree**				**Agree**
1.	My pain was caused by physical activity.	1	2	3	4	5
2.	Physical activity worsens or did worsen my pain.	1	2	3	4	5
3.	Physical activity might harm my back.	1	2	3	4	5
4.	I should not do physical activities because this might make my pain worse.	1	2	3	4	5
5.	I cannot do physical activities because they do or could make my pain worse.	1	2	3	4	5
	YOUR NORMAL WORK AND BACK PAIN	**Disagree**				**Agree**
6.	My pain was caused by my work or by an accident at work.	1	2	3	4	5
7.	My work aggravates my trouble.	1	2	3	4	5
8.	I have a claim for compensation for my pain.	1	2	3	4	5
9.	My work is far too heavy for me.	1	2	3	4	5
10.	My work makes or made my pain worse.	1	2	3	4	5
11.	My work might harm my back	1	2	3	4	5
12.	I should not do my normal work when I am in pain.	1	2	3	4	5
13.	I cannot do my normal work when I am in pain.	1	2	3	4	5
14.	I should avoid my normal work until my pain is treated.	1	2	3	4	5
15.	I do not think that I will ever be able to do my present work normally.	1	2	3	4	5

SECTION 4: Work Satisfaction

Below are statements that help us understand your general work situation.
Please answer ALL statements and indicate whether you agree or disagree with each statement by circling the appropriate number on the scale ranging from
1 COMPLETELY DISAGREE to 5 COMPLETELY AGREE

Remember that your employer(s) and your immediate boss will NOT see your answers

		Disagree				gree
1.	I enjoy my work	1	2	3	4	5
2.	My job meets my expectations	1	2	3	4	5
3.	I can turn to a fellow worker for help when I have problems	1	2	3	4	5
4.	I get satisfaction from my job	1	2	3	4	5
5.	I like most of my fellow workers	1	2	3	4	5
6.	My job is mentally demanding	1	2	3	4	5
7.	I enjoy the tasks involved in my job	1	2	3	4	5
8.	My fellow workers talk things over with me	1	2	3	4	5
9.	My job involves a great deal of mental concentration	1	2	3	4	5
10.	I am happy with my job	1	2	3	4	5
11.	My job involves a great deal of responsibility	1	2	3	4	5
12.	I would recommend my job and place of work to a friend	1	2	3	4	5
13.	My job causes me worry	1	2	3	4	5
14.	I would choose the same job, in the same place, again	1	2	3	4	5
15.	My fellow workers accept and support my new ideas	1	2	3	4	5

Thank you completing this questionnaire!

Appendix III

List of medical conditions that may increase the risk of disorders of the spine or other organs and structures in workers exposed to whole-body vibration

At the pre-placement and periodic health examinations of workers exposed to whole-body vibration (WBV), the occupational health physician shall record the case history to investigate symptoms and signs of disorders possibly caused by excessive exposure to WBV. Since all symptoms and signs associated with these disorders may be found in several other diseases, the physician shall consider all pathological conditions which can either increase the susceptibility of the individual to the adverse health effects of WBV or worsen vibration-induced injuries to the spine or other organs.
The following medical conditions may increase the risk of disorders of the spine or other organs and structures in workers exposed to WBV:

Disorders of the spine

- Distinct premature (not related to age) degenerative changes in the spine
- Disorders of the intervertebral disc (with or without radicular syndromes)
- Active inflammatory conditions of the spine
- Manifest acquired or congenital deformation of the spine
- Surgery of the spine
- Earlier spinal injuries with fractures of vertebrae
- Recurrent episodes of chronic back pain

Other conditions

- Severe neck-shoulder disorders
- Chronic gastritis and/or gastric or duodenal ulcers
- Pregnancy

Appendix IV

Physical examination methods of the lower back

Examination of the back function and evaluation of the effects of pain:

The patient should be barefoot and wear a standard patient gown that is open in back.

Patient standing

The examiner should stand behind the patient and observe the general configuration of the spine to detect any lateral curvatures, kyphosis, or excessive lordosis in the erect posture.

- Forward flexion: the patient is asked to flex forward as far as possible and indicate any pain or discomfort. The examiner should observe the lumbar paraspinous muscles. Any eccentric contractions of the musculature suggest lumbosacral paraspinous spasms; limited motion without evidence of such eccentric contractions suggests lack of patient co-operation. Normal subjects should be able to nearly touch their toes. In general, pain increased by flexion suggests lumbar disc abnormalities. Pain increases with repetitive flexions in patients with discogenic pain. Forward flexion is often associated with a list to one side. Occasionally, patients with lumbosacral paraspinous spasm will be able to flex forward reasonably normally but will have difficulty returning to the erect position. Abnormal spinal rhythm is a typical feature in the clinical diagnosis of instability syndrome. In extreme examples, the patient may "climb up" his/her thighs to return from the flexed position. The range of motion is recorded as the distance of the fingertips from the floor or to the knees.
  The patient shall return to erect position and a short rest before the next test.
- Extension: during spinal extension, the examiner should ensure that the patient's hips and knees remain locked. Particular attention should be paid to movement in the lumbar area, and this should be distinguished from hip extension. The patient is asked about the reproduction of typical back pain. Pain increased by (repetitive) extension suggests degenerative changes involving posterior elements of the spine, lumbar spinal stenosis, or both. The range of motion is not measured. The patient shall return to the erect position and a short rest before the next test.
- Lateral flexion: the patient is asked to flex to the side and indicate any pain or discomfort. Normal subjects should be able to reach the fibular heads with their fingertip. The examiner should compare the range of motion to the left and to the right.
- Muscle weakness. The power of plantar flexion is tested by having the patient perform 10 toe raises standing on both feet and then 10 more standing on each foot separately. Repeated activity causes fatigue of the calf muscles and reveals minimum differences in the strength of muscles innervated by the S1 nerve root. The strength of the dorsiflexors, innervated by the L4 and L5 nerve roots, is tested by having the patient walk on his/her heels.
- Quadriceps is tested by having the patient squat holding on to the examiner's hand for balance.
- The hip abductor muscles are tested in the Trendelenburg's test, in which the patient is asked to stand on one leg and then the other, while the examiner sits behind the patients with his hands on the patient's iliac crests. Any drop of the pelvis on the side opposite the stance leg constitutes a positive sign of weakness of the abductors on the stance leg indicating that the L5 nerve root is affected.

Patient sitting on the examination table.

- Peripheral neurologic examination: the knee and Achilles reflexes are tested with the patient sitting on the examining table with legs hanging free. A distinct strike with the reflex hammer on the tested tendon will produce an unvoluntary extension jerk of the lower leg and the foot respectively. Alternatively, for testing the Achilles reflex the patient can be kneeling on a chair holding on to the back of the chair with both hands.
- With the patient sitting or lying on the examination table the strength of the extensor hallucis longis is tested by applying a resistance against extension of the both halluces. Weakness indicates that the L5 nerve root is affected.
  Quadriceps can be tested with the patient sitting on the examination table and asked to extend his/her lower leg from the knee. The examiner puts a resistance against the extension and compares the strength with the unaffected leg. Weakness indicates that L3 and L4 nerve roots are affected. Hip flexion is tested with the patient sitting on the examination table and asked to lift his/her leg up from the table. The examiner puts one hand just above patella and applies resistance by pressing down on the thigh. Weakness indicates that L1 and L2 nerve roots are affected.

Patient lying supine.

- Straight leg raising test is the classic test of sciatic nerve irritation. The examiner stands to one side of the patient, places one hand on the patient's knee to extend the knee and the other hand under the patient's heel and then lifts the leg while keeping the knee straight. A positive result produces typical pain radiating down the back of the thigh below the knee and to the foot while the leg is elevated 60 degrees or less at the hip. However, S1 and occasionally, L5 irritation can stop at the buttocks or posterior thigh. Symptoms produced at elevations greater than 60 degrees may represent irritation of the nerve root, but frequently reflect referred mechanical back pain or hamstring tightness. The examiner should also perform the crossed straight leg raising test by lifting the well leg. If this causes pain on the affected side this demonstrates an extreme irritability of the affected nerve root. Crossover pain describes a situation when pain is produced in the normally asymptomatic leg when the affected leg is lifted. Crossover pain indicates central disc herniation.
- Sensitivity is tested by light strokes, using the index and middle fingers, bilaterally on the medial, anterior and lateral sides of the lower leg, the dorsal, lateral, and medial surface of the foot.
- Back muscle endurance test may be indicated when back pain has been present for a long period of time (months). The patient is lying prone on the examination table. A chair is placed at the top end of the table. The patient's legs and pelvis are supported by the table. The upper trunk is outside the top end of the table and the patient supports himself by his hands on the chair. The legs are either strapped or held down by the examiner when the patient is asked to extend his

upper body and put his hands behind his back. Normal or good endurance is the ability to hold the position for 4 minutes at which time the test is interrupted.

– **Waddell's** tests consist of five nonorganic physical signs to identify those patients who have a significant psychologic or socioeconomic basis for their pain.

1. *Nonorganic tenderness* may include either broad, superficial tenederness to light touch in the lumbar region and/or widespread deep tenderness in a nonanatomic distribution.
2. *Simulation tests* suggest to the patient that a specific examination is being performed though, in fact, it is not. For example, low back pain produced with either axial loading of the skull or passive rotation of the shoulders and pelvis in the plane through the hips suggests involvement of nonorganic factors in the pain response.
3. *Distraction tests* attempt to reproduce positive physical findings while the patient's attention is distracted. A positive supine straight-leg raising response may be suspect if the patient can flex his/her hip to 90º with the knee extended in the sitting position.
4. *Regional disturbances* are sensory and motor abnormalities that involve multiple regions and are unexplained on a neuroanatomic basis. "Give way" weakness and sensory loss in a "stocking", rather than dermatomal, distribution probably have a nonorganic component.
5. *Overreaction* during examination is statistically the most important nonorganic physical sign. Disproportionate verbalisation, inappropriate facial expression, tremor, collapsing, and sweating are all manifestations of this Waddell sign.