



GUIDELINES FOR WHOLE-BODY VIBRATION HEALTH SURVEILLANCE

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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. A prototype health surveillance scheme for WBV is presented in this paper. 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 2 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. This paper presents opinions on health surveillance for whole-body vibration developed within a working group of partners funded on a European Community Network (BIOMED2 concerted action BMH4-CT98-3251: Research network on detection and prevention of injuries due to

occupational vibration exposures). The health surveillance protocol and the draft questionnaire with explanation comments are presented for wider consideration by the science community and others before being considered appropriate for implementation.

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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 [1–5]. Owing to the cross-sectional design of the majority of the studies performed there are not yet sufficient data to outline a clear exposure–response relationship between WBV exposure and LBP disorders. From epidemiologic studies on driving occupations, it will always be difficult to differentiate the relative role of WBV and other risk factors in the aetiology of LBP disorders. Furthermore, the majority of the performed studies were of a cross-sectional character (with possibilities for health-based selection). Nevertheless, in many ways comparable, in the studies of Bongers, Boshuizen and Hulshof [6], Bovenzi and Betta [7], and Schwarze *et al.* [8], a trend for an increasing risk for low back pain with increasing WBV exposure can be determined. In one meta-analysis [6], an increase of the prevalence odds ratio for low back pain of 1.7 per m/s^2 was calculated. The findings of a later meta-analysis [3] were in the same order and in addition Schwarze *et al.* [8] and Lings and Leboeuf-Yde [5] added valuable information to this. Biodynamic and physiological experiments have shown that seated WBV exposure can affect the spine by mechanical overloading and muscular fatigue supporting the epidemiological findings, and supporting the possible causal role of WBV in the development of back trouble [9]. Other data also show that in particular, the combination of postural load and exposure to WBV (which is often the case in vehicles) may increase the risk of spinal damage [8, 10, 11].

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 [12–14]. 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 recognized as an occupational disease [15, 16].

This paper presents opinions on health surveillance for whole-body vibration developed within a working group of partners funded in a European Community Network (BIOMED2 concerted action BMH4-CT98-3251: Research network on detection and prevention of injuries due to occupational vibration exposures). A health surveillance protocol and a draft questionnaire with explanatory comments are presented for wider consideration by the scientific community and others before being considered appropriate for implementation.

1.2. PREVENTION MEASURES

In many workplaces, exposure to WBV is still not recognized as a serious problem and many occupational health and safety services have a lack of experience in the prevention of adverse health effects. Different elements of prevention can be distinguished: technical prevention aimed at elimination or reduction of WBV at the source, organizational changes

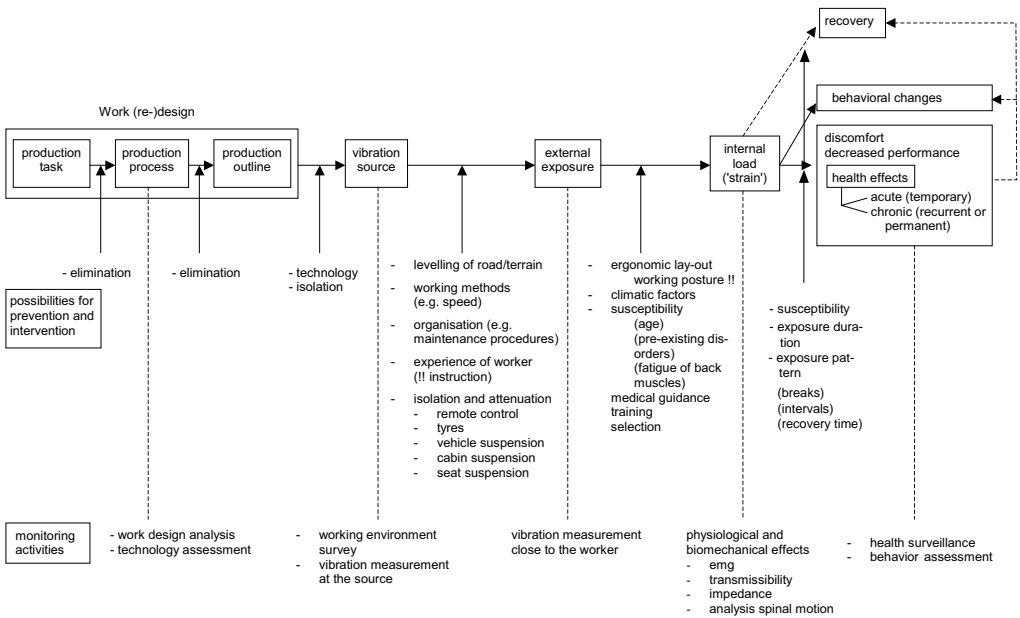


Figure 1. Model of sequence of preventive possibilities [17].

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) [17].

In addition to technical measures, such as 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 fundamental 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 [18]. 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 [19]. 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 worker's health surveillance programme must ensure the professional independence and impartiality of the health professionals, worker's privacy and confidentiality of individual health information. Fine [20] 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 [21] 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 multi-level 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.* [22] suggest surveillance to identify work-related risks initially using national statistics. Davis [23] suggests an occupational health audit as one way to get the job started. Sorock *et al.* [24] 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 [25] 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 is 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 programme 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

also be 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 an expertise in occupational medicine or at least with certified training in occupational health. Practical routine procedures for the application of the health surveillance programme 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 between the occupational health physician and 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 A).

3.1.1. *The case history*

The case history should focus on:

- (1) Social personal history including use of tobacco and alcohol and being involved in physical activities.
- (2) 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 also be investigated.
- (3) Sports activities or hobbies during leisure time, which may impose high spinal loads should be included.
- (4) 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 standardized questionnaire. The questions should be validated and the answers should be easy to analyze [26, 27]. The use of clinical practical guidelines for LBP is recommended [28].

As part of employee education and health surveillance, the occupational health professional should provide information on the possible preventative measures to avoid or minimize 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:

- (1) Examination of the back function and evaluation of the effects on pain: forward flexion, extension, lateral flexion.
- (2) Straight leg raising test.
- (3) Peripheral neurological examination: knee and Achilles tendon reflexes, sensitivity in leg/foot, signs of muscle weakness (extension leg m quadriceps, flexion/extension big toe/foot).
- (4) Back endurance test (tentative extra test).
- (5) Waddell's signs of non-organic pain [29].

Note 2: Appendix D provides 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 usual 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 C 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 at regular intervals. The main purposes of the periodic health examination are the same as those 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 intervals related to the average exposure, i.e., workers with exposures above the limit value every year or every second year and workers above the old or new (0.5 or 0.6 m/s^2) action level once in 4 years. 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 has 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 that 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 B). Moreover, any illness or injury listed in Appendix C and which has occurred since the last examination,

and any symptom possibly related to vibration exposure as well as the findings of the physical examination should also be 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 by disorders possibly related to whole-body vibration and listed in Appendix C 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 replacement 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 the problems are, how big they are, where the solutions should be directed, how well (or poorly) 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. One problem with back disorders is the great variability in the repeatability of physical examination findings and clinical conclusions. However, we included only a few of all possible tests and have included detailed descriptions of these tests to improve repeatability. There is also the study by Viikari-Juntura *et al.* [30], who concluded that most tests in an occupational health population are quite repeatable. Waddell's signs for non-organic pain are reported as being repeatable [31]. Thus, we believe that there is sufficient evidence regarding the repeatability and validity of these tests to be used in the protocol. There are no pathognomic features which distinguish vibration-associated back pain from other causes of back pain. However, back pain due to exposure to WBV is not a specific effect as other factors are always present, such as posture. The matter of specificity, i.e., whether the effect is specific to the stressor, does not confer greater validity to any causal inference regarding the exposure effect [32]. With a multi-causal disease or disorder like LBP, it will probably never be possible to give a clear answer of cause. The question is whether this answer is needed. Regardless of the fact that the impact of other (personal or work-related) stressors may sometimes be more dominant than WBV, evidence of the relationship between WBV and LBP would justify by itself the attention of possibilities of prevention. Given the burden of consequences of low back pain to the individual workers and to society, every possibility to undertake action should be stimulated. One matter for 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.

Article 8 of the "Amended proposal for a Directive of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration)" describes the requirements and content

of appropriate health surveillance measures. The purpose is the prevention and early diagnosis of every disorder due to exposure to vibration. Our recommendations on health surveillance are in general well in line with the regulations in Article 8 of the Directive. Our definition of health surveillance is maybe somewhat broader than that suggested in the Directive and includes a more systematic collection of data on exposure and in our view, the valuable purpose of providing information to the exposed workers on the potential harm and the possibilities for prevention. This is in line with a recent article on health surveillance by Choi *et al.* [33], in which their definition of a sentinel health event may be a health outcome, an occupational exposure or an intervention strategy. Health surveillance should involve all these three aspects. The Directive states that health surveillance is recommended when workers are exposed above the daily exposure of $> 0.6 \text{ m/s}^2$ or a limit value of $> 1.15 \text{ m/s}^2$. We do not make a reference to a certain value or action level for which health surveillance is advised. In the past, there have been indications of an elevated risk with even lower levels than the chosen limit in the Directive. Therefore, we think that almost every one who is driving a vehicle professionally should have the option of health surveillance. However, neither the Physical Agents Directive nor this Document on Guidelines for WBV health surveillance are evidence-based standards. Although much of what is presented in this document is based on research and on consensus and personal experience within the drafting group, the suggested method of health surveillance itself is not yet evaluated in a scientific rigorous way. It should therefore be the object of future research.

German [34] suggests 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.* [35] 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 a correlation 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 realized that this simple structure was not really adequate. Later the structure of the computerized 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 descriptors for evoking the appropriate risks.

In another approach, Holzner *et al.* [36] 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.

A good health surveillance programme can be cost-effective. The amount of money is not very difficult to estimate. It consists of different aspects: costs of the occupational health service personnel involved, travel expenses for the worker, costs for the employer due to absence from work, etc. Our experience with this kind of periodical occupational health examination is that the whole examination itself will take about 45 min to an hour for each worker: 15 min preparation by a medical assistant and 30–45 min with the physician. The questionnaire can be sent to the worker's home a few days before the examination, the worker completes it and takes it along to the occupational health service. In many cases the use of the questionnaire, which can be used as a self-completed one, together with more specific questioning on recent episodes of prolonged back pain is the core of the health surveillance method. However, in our view, health surveillance is also dealing with matters

of exposure and of intervention strategies, such as presenting information on harmful exposures and harmful habits. Other professionals, like hygienists and nurses, not necessarily doctors, can provide this information. Also, other instruments like leaflets and videos can play a valuable role in this.

Lukes [37] provides an example of changes made to a medical/health surveillance programme that resulted in cost savings while increasing services to employees [37]. Further development of these and other methods is encouraged, especially in the light of technological advancements in data capture, analysis and presentation. Only through such efforts can epidemiologic principles be best applied to the prevention of injuries in the workplace.

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APPENDIX A: 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: _____ m(ft) _____ cm(in)

Weight: _____ kg(lbs)

Marital Status: Single Married

Divorced/Separated Widowed

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? (km(miles): less than /8,000 (5000) 8–24,000(5–15,000)
 more than 24,000 (15,000)
- 6. How many school years have you completed? _____ years
- 7. What sports, if any do you weekly participate in? _____
- 8. Do you have more than one job? Yes No

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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
twisted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
lean against backrest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
any other constrained posture? _____			

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 5 kg (10lbs) 5-10 kg (10-20lbs) More than 10kg(20lbs)
 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

any other constrained posture? _____

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

_____ for _____ years

13. Did you drive in your previous jobs on vehicles like: trucks, buses, 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

any other constrained postures? _____

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 2-4 More than 4	0	1 2-5 6-10 More than 10
4. How long did they typically last?	Not applicable	Hours	Not applicable	Hours
	1-2 days	Always	1-2 days	3-6 days 1-3 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 3-5 days	1-2 days More than 5 days	None 4-6 months	1-4 weeks 1-3 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 2-4 More than 4	0	1 2-5
			6-10	More than 10
4. How long did they typically last?	Not applicable	Hours	Not applicable	Hours
	1-2 days	Always	1-2 days	3-6 days 1-3 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	None	1-4 weeks 1-3 months
	3-5 days	More than 5 days	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	Namely	No	Namely
	Yes		Yes	
7. Have you <u>ever</u> had a trauma to your back that required a medical visit?	No	What kind of trauma?	When did it happen?	
	Yes			
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, or other?)	None	Namely	None	Namely
	Yes		Yes	
9. Is there any movement or activity that causes your pain?	No	Namely	No	Namely
	Yes		Yes	
10. Is there any movement or activity which aggravates your pain?	No	Namely	No	Namely
	Yes		Yes	
11. Do you usually get neck pain during or shortly after driving a vehicle?	No	Typically for how long?	No	Typically for how long?
	Yes		Yes	

[†]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 2-4 More than 4	0 6-10	1 2-5 More than 10
4. How long did they typically last?	Not applicable	Hours	Not applicable	Hours
	1-2 days	Always	1-2 days	3-6 days 1-3 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	None	1-4 weeks 1-3 months
	3-5 days	More than 5 days	4-6 months	More than 6 months
6. Has a doctor told you what was wrong with your shoulder, i.e., given a diagnosis?	No	Namely	No	Namely
	Yes		Yes	
7. Have you <u>ever</u> had a trauma to your shoulders that required a medical visit?	No	What kind of trauma?	When did it happen?	
	Yes			
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, or other?)	None	Namely	None	Namely
	Yes		Yes	
9. Is there any movement or activity that causes your pain?	No	Namely	No	Namely
	Yes		Yes	
10. Is there any movement or activity which aggravates your pain?	No	Namely	No	Namely
	Yes		Yes	
11. Do you usually get shoulder pain during or shortly after driving a vehicle?	No	Typically for how long?	No	Typically for how long?
	Yes		Yes	

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

Upper back

No Yes

Knees

No Yes
 in the right knee
 in the left knee
 in both knees

Wrists/hands

No Yes
 in the right wrist/hand
 in the left wrist/hand
 in both wrists/hands

Hips/thighs/buttocks

No Yes
 in the right hip
 in the left hip
 in both hips

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		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 irregularities 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 B: 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: _____ m(ft) _____ cm(in) Weight: _____ kg(lbs)

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

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? (km(miles)): less than 8,000 (5000) | | 8–24,000 (5–15,000), | |
 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 | | 41–60 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, other)
- | 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 | <input type="checkbox"/> no | <input type="checkbox"/> yes | _____ hours/day | _____ type of vehicle |
| poor condition | <input type="checkbox"/> no | <input type="checkbox"/> yes | _____ hours/day | _____ type of vehicle |

stelcon-plates	<input type="checkbox"/> no	<input type="checkbox"/> yes	___ hours/day	_____ type of vehicle
paved road (cobbel)	<input type="checkbox"/> no	<input type="checkbox"/> yes	___ hours/day	_____ type of vehicle
track/rail	<input type="checkbox"/> no	<input type="checkbox"/> yes	___ hours/day	_____ type of vehicle
off-road	<input type="checkbox"/> no	<input type="checkbox"/> yes	___ hours/day	_____ type of vehicle
construction road	<input type="checkbox"/> no	<input type="checkbox"/> yes	___ hours/day	_____ type of vehicle
other, namely	<input type="checkbox"/> no	<input type="checkbox"/> 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 back rest give good support of your back? yes no
- Do you use a separate back support when you drive? yes no
- Does your seat have arm rests? yes no
- Do you use arm rests when you drive? yes no not applicable

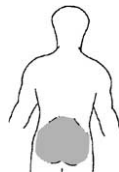
11. Which postures do you adopt when driving? Often Occasionally Never
- | | | | |
|--------------------------------------|--------------------------|--------------------------|--------------------------|
| bent forward | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| twisted | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| lean against backrest | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| any other constrained posture? _____ | | | |
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 <input type="checkbox"/> | no <input type="checkbox"/> |
| fore/aft vibration | yes <input type="checkbox"/> | no <input type="checkbox"/> |
| side-to-side vibration | yes <input type="checkbox"/> | no <input type="checkbox"/> |
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 5 kg (10 lbs) 5–10 kg (10–20 lbs) More than 10 kg (20 lbs)
 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
21. 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
 any other constrained posture? _____
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 do 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 2-4 More than 4	0	1 2-5 6-10 More than 10
4. How long did they typically last?	Not applicable	Hours	Not applicable	Hours
	1-2 days	Always	1-2 days	3-6 days 1-3 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	None	1-4 weeks 1-3 months
	3-5 days	More than 5 days	4-6 months	More than 6 months
6. Has a doctor told you what was wrong with your back, i.e., given a diagnosis? [†]	No	Namely	No	Namely
	Yes		Yes	
7. Have you ever had a trauma to your back that required a medical visit?	No	What kind of trauma?	When did it happen?	
	Yes			
8. What treatment did your doctor prescribe? (Anti-inflammatory drugs, painkillers, physical therapy, surgery, other?)	None	Namely	None	Namely
	Yes		Yes	
9. Is there any movement or activity that causes your pain?	No	Namely	No	Namely
	Yes		Yes	
10. Is there any movement or activity which aggravates your pain?	No	Namely	No	Namely
	Yes		Yes	
11. Do you usually get back pain during or shortly after driving a vehicle?	No	Typically for how long?	No	Typically for how long?
	Yes		Yes	

[†]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 2-4 More than 4	0 6-10	1 2-5 More than 10
4. How long did they typically last?	Not applicable	Hours	Not applicable	Hours
	1-2 days	Always	1-2 days	3-6 days 1-3 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 3-5 days	1-2 days More than 5 days	None 4-6 months	1-4 weeks 1-3 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 <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, 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 2-4 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 1-3 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 3-5 days More than 5 days		None 1-4 weeks 1-3 months 4-6 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, 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 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

Upper back

No Yes

Knees

No Yes
 in the right knee
 in the left knee
 in both knees

Wrists

No Yes
 in the right wrist/hand
 in the left wrist/hand
 in both wrists/hands

Hips/thighs/buttocks

No Yes
 in the right hip
 in the left hip
 in both hips

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		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 irregularities 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	

3.7. ROLAND AND MORRIS DISABILITY QUESTIONNAIRE

This list contains sentences that people have used to describe themselves when they have back pain. When you read them, you may find that some describe yourself. As you read the list, think of yourself *today* and circle the ‘yes’ or ‘no’ options accordingly.

(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	no
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 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 get out of a chair because of my back.	yes	no
13. My back is painful almost all the time.	yes	no
14. I find it difficult to turn over in bed 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	no
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	5
2. Physical activity worsens or did worsen my pain.	1	2	3	4	5	5
3. Physical activity might harm my back.	1	2	3	4	5	5
4. I <u>should</u> not do physical activities because this might make my pain worse.	1	2	3	4	5	5
5. I <u>cannot</u> do physical activities because they do or could make my pain worse.	1	2	3	4	5	5
 YOUR NORMAL WORK AND BACK PAIN						
6. My pain was caused by my work or by an accident at work.	1	2	3	4	5	5
7. My work aggravates my trouble.	1	2	3	4	5	5
8. I have a claim for compensation for my pain.	1	2	3	4	5	5
9. My work is far too heavy for me.	1	2	3	4	5	5
10. My work makes or made my pain worse.	1	2	3	4	5	5
11. My work might harm my back.	1	2	3	4	5	5
12. I <u>should</u> not do my normal work when I am in pain.	1	2	3	4	5	5
13. I <u>cannot</u> do my normal work when I am in pain.	1	2	3	4	5	5
14. I should avoid my normal work until my pain is treated.	1	2	3	4	5	5
15. I do not think that I will ever be able to do my present work <u>normally</u> .	1	2	3	4	5	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			Agree	
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 for completing this questionnaire!

APPENDIX C: 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 D: 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 the 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 paraspinal muscles. Any eccentric contractions of the musculature suggest lumbosacral paraspinal 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 paraspinal 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 are 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 patient 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 involuntary 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 longus* is tested by applying a resistance against extension of both the 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° 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° 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 min at which time the test is interrupted.

Waddell's tests consist of five non-organic physical signs to identify those patients who have a significant psychologic or socio-economic basis for their pain.

- (1) *Non-organic tenderness* may include either broad, superficial tenderness 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 non-organic 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 90° 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 non-organic component.
- (5) *Overreaction* during examination is statistically the most important non-organic physical sign. Disproportionate verbalization, inappropriate facial expression, tremor, collapsing, and sweating are all manifestations of this Waddell sign.