Risks of Occupational Vibration Exposures

VIBRISKS

FP5 Project No. QLK4-2002-02650
January 2003 to December 2006

VÄSTERBOTTENS LÄNS LANDSTING

Annex 14 to Final Technical Report

Title: Longitudinal epidemiological surveys in Sweden of drivers exposed to whole-body vibration

Authors: Ronnie Lundström, Tohr Nilsson, Anna Ekman, Andreas Jonsson, Mats Hagberg, Lage Burström

Organisation: Department of Biomedical Engineering & Informatics, University Hospital of Northern Sweden

European Commission

Quality of Life and Management of Living Resources Programme
Key Action 4 - Environment and Health

31st January 2007

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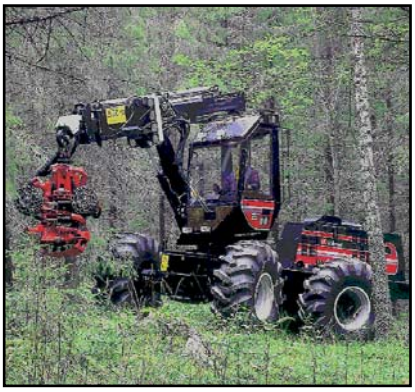
1 Longitudinal surveys of WBV-exposed workers in Sweden

1.1. Subjects and Methods

1.1.1 Study population

The baseline study population consists of 530 male professional drivers of forestry vehicles, such as harvesters, forwarders and mounders, comprising the census of drivers in the northern part of Sweden.

Harvester Forwarder



During 2004 they received a Swedish version of the self-administered whole-body vibration questionnaire (VIBRISKS Working document WP4-N6) prepared in WP4 (VIBRISKS Working document WP4-N5). Altogether 322 drivers replied (response rate: 61%) among which 11 declared that they were not willing to participate. The number of forestry machine drivers included in the final baseline analysis is thus 311.

During 2006 the Swedish version of the self-administered whole-body vibration follow-up questionnaire (VIBRISKS Working Document WP4-N15) was posted to the final baseline study group. Altogether, and after two reminders, 225 drivers have by the end of November 2006 replied (response rate: 73%). General data for the baseline study group and the follow-up study group is shown in Table 1, such as age, weight, length and body mass index (BMI).

Table 1.: General data for the study group (Mean (±Sd)/Min/Max).

	Age (yrs)	**Length** (m)	**Weight** (kg)	**BMI**
Baseline (n=311)	45(12.2)/20/66	179(6.5)/159/198	86(12.3)/60/130	26.7(3.4)/19.6/42.4
Follow-Up (n=225)	45.1(11.8)/21.2/67.3	179.5(6.4)/160/197	86.5(11.4)/60/130	26.8(3.2/20.4/40.8

1.1.2 The self-administered baseline and follow-up questionnaires

Personal, occupational and health histories of the included forestry machine drivers were collected by means of Swedish versions of the standardized self-admininstered baseline and follow-up questionnaires (VIBRISKS Working documents WP4-N6 and N15, respectively) which were adapted within Work Package 4 of the VIBRISKS project, i.e. VIBRISKS Working documents WP4-N5 and N13.

The Swedish version of the baseline and follow-up questionnaires includes 49 questions and may require up to a hour to complete. Both questionnaires are divided into five main sections and include questions about:

1. Personal characteristics, habits and sporting activities.
2. The current job and its environment, working activities (lifting, digging, postures etc) and the vehicles which are being driven (type of vehicles, time spend driving etc).
3. Previous jobs
4. Health, eg. ache and pains in different parts of the body (low back, neck and shoulders) and in different times (last 7 days and last 12 months)
5. Symptoms and feelings in other regions of the body, such as elbows, arms, hands).

The baseline questionnaire with accompanying information letter, including a general description of the current project, research ethics approval, and a pre-paid return envelope was sent by mail to each forestry machine driver. Each questionnaire was coded by a reference number so that privacy was taking into account. After 20 days a first reminder was send to the participants who did not respond. After additional 20 days a second reminder was sent. The same procedure was followed for the follow-up questionnaire.

1.1.3 Measurements and assessment of vibration exposure

Vibration measurements have been conducted on a representative sample of forestry machines. Vibration was measured at the driver-seat interface during normal operating conditions according to the recommendations of the International Standard ISO 2631-1. These measurement data, together with data measured by the research team in earlier research settings then formed the base for dose assessments. Individual WBV exposure doses are calculated in accordance with the protocol for calculation of dose measures for whole-body vibration (WP4-N14).

1.2 Results

1.2.1 Base-line study

The base-line study was conducted, with respect to the assessment of health and exposure for vibration and postural stressor, according to the protocol for epidemiological studies developed in VIBRISKS WP4 (WP4-D4. Protocol for epidemiological studies on whole-body vibration). Table 2 provides a summary of obtained data for the base-line investigation including prevalence of musculoskeletal symptoms in the neck, shoulder, and low back (the last 7 days, the last 12 months), and the VAS score for the musculoskeletal pains at the various body locations and the Roland Morris score in the cross-sectional survey of the study population.

Table 3 provides metrics of vibration exposure according to the protocol for dose calculations. (For more information, see Appendix 2 in WP4 Report D4).

Table 2. Population summary for the base-line study.

Population	**SWEDISH FORESTRY VEHICLE DRIVERS**				
Number exposed	311				
Vehicles	Harwarder	Forwarder	Mounder	Snowmobile	4 wheeler
From WBV dose calculation (m/s^2 r.m.s):					
Average $a_{x,w}$	0.25	0.5	0.7	0.7	0.7
Average $a_{y,w}$	0.4	0.8	1.1	0.7	0.7
Average $a_{z,w}$	0.3	0.6	0.6	0.8	0.8
Number indicated driving	208	170	12	16	6
Average daily duration (minutes)	404	350	34	41	19
SD daily duration	146	176	15	47	20
Max daily duration	720	780	57	180	60
Min daily duration	12	12	15	12	6
Average years of exposure for all vehicles					19.2
SD years of exposure for all vehicles					12.4
Max years of exposure for all vehicles					49.3
Min years of exposure for all vehicles					0.2
Percent with more than 1 year of occupational exposure to WBV prior to current job					22 %
From questionnaire (symptoms):					
% with low back pain in last 7 days					32.2 %
% with low back pain in last 12 months					57.9 %
VAS score for lower back					3.3/10
Roland disability scale score (response rate 41%)					3.8/24
% with neck pain in last 7 days					38.6 %
% with neck pain in last 12 months					54.3 %
VAS score for neck pain					3.8/10
% with shoulder pain in last 7 days					26 %
% with shoulder pain in last 12 months					39.5 %
VAS score for shoulder pain					3.9/10

Table 3. Mean (±SD) values for vibration exposure doses (Dose1 – Dose 14) calculated for all drivers in the baseline study group (i.e. N=311).

Dose	Formula	Mean (±SD)	Unit
1	$T = \sum t_{Ti}$	30805 (22809)	h
2	$\sum a_{wsi}.t_i$	32160 (27536)	$ms^{-2}.h$
3	$\sum a_{wsi}^2 t_i$	37843 (40363)	$m^2s^{-4}.h$
4	$\sum a_{wsi}^4 t_i$	67575 (94916)	$m^4s^{-8}.h$
5	$\sum a_{wqi}.t_i$	45040 (34609)	$ms^{-2}.h$
6	$\sum a_{wqi}^2 t_i$	67288 (55575)	$m^2s^{-4}.h$
7	$\sum a_{wqi}^4 t_i$	159932 (158555)	$m^4s^{-8}.h$
8	$\left\| [(\sum a_{wsi}^2 t_i)/ (\sum t_i)]^{½} \right\|_{max}$	159932 (158555)	ms^{-2}
9	$\left\| [(\sum a_{wqi}^4 t_i)/ (\sum t_i)]^{¼} \right\|_{max}$	1.53 (0.28)	ms^{-2}
10	$Y = \left\| D_2 - D_1 \right\|_{max}$	19.2 (12.4)	y
11	$\left\| t_{d(n)} \right\|_{max}$	7.1 (2.35)	hours
12	$A(8) = \left\| (\sum a_{wsi}^2.t_{di}/T_{(8)})^{½} \right\|_{max}$	0.97 (0.37)	ms^{-2}
13	$VDV = \left\| a_{wqi}.(t_{di}.60.60)^{¼} \right\|_{max}$	18.3 (3.43)	$ms^{-1.75}$
14	$A(8) = (\sum a_{wsi}^2.t_{di}/T_{(8)})^{½}$	1.02 (0.37)	ms^{-2}

The life-time exposure to WBV (in hours) for each individual driver (i.e. Dose 1) have been divided in to three sub groups of life-time exposure (Table 4) based on tertiles, i.e. G1, G2 and G3. The table also shows prevalence at baseline of neck, shoulder and low back symptoms experienced at any time during the last seven days or the last 12-month period respectively, within each of the three sub groups.

Table 4: Mean (±SD) life-time WBV exposure, BMI and age plus prevalences (%) of symptoms within exposure sub groups (G1,G2 and G3) of forestry machine drivers (standard deviation).

	G1 (n=104)		**G2** (n=101)		**G3** (n=106)	
Exp time (hrs)	10265 (±7091)		35142 (±7497)		74264 (±22796)	
BMI	25.7 (±3.0)		27.0 (±3.2)		27.5 (±3.6)	
Age	33.6 (±11.1)		42.9 (±9.1)		53.2 (±7.1)	
PREVALENCES	**7 days**	**12 months**	**7 days**	**12 months**	**7 days**	**12 months**
Neck	39.4	52.9	38.6	51.5	37.8	58.5
Shoulder	19.2	36.5	31.7	42.6	27.4	39.6
Low back	28.9	58.7	31.7	60.4	35.9	55.2

Age adjusted prevalence ratios (95% confidence intervals) of self-reported complaints of neck, shoulder and low back pain are shown in Table 5.

Table 5: Age adjusted prevalence ratios (95% confidence intervals).

	During the last 7 days	During the last 12 months
Neck pain 	G2/G1: 0.911 (0.555—1.495) G3/G1: 0.822 (0.440-1.537)	G2/G1: 0.998 (0.648-1.536) G3/G1: 1.232 (0.708-2.144)
Shoulder pain 	G2/G1: 1.368 (0.735—2.547) G3/G1: 1.384 (0.590—3.244)	G2/G1: 1.089 (0.667-1.780) G3/G1: 1.139 (0.589-2.205)
Low back pain 	G2/G1: 0.982 (0.557-1.730) G3/G1: 0.991 (0.502-1.995)	G2/G1: 0.995 (0.666-1.486) G3/G1: 0.994 (0.579-1.706)

As can be seen in Table 4, the prevalence for each category of symptom is quite similar between exposure sub groups. This finding is also confirmed by the statistical calculation of age adjusted prevalence ratios shown in Table 5.

Possible exposure-response (for symptoms) or dose-effect (for score test results) relationships at the cross-sectional survey is presented in table 6.

Table 6. Odds ratios with 95 % confidence interval for low back pain last 12 months at baseline.

	N	OR	95 % CI
Dose 1			
Q1/Q0	295	1.1	0.559 - 2.232
Q2/Q0	295	1.0	0.480 - 2.205
Q3/Q0	295	1.0	0.426 - 2.555
Age	295	1.0	0.974 - 1.028
BMI	295	1.0	0.888 - 1.028
Dose 3			
Q1/Q0	295	0.79	0.399 - 1.577
Q2/Q0	295	0.72	0.341 - 1.542
Q3/Q0	295	0.72	0.320 - 1.641
Age	295	1.0	0.982 - 1.032
BMI	295	0.96	0.890 - 1.030
Dose 14			
Q1/Q0	295	1.1	0.565 - 2.227
Q2/Q0	295	0.91	0.447 - 1.870
Q3/Q0	295	0.70	0.345 - 1.431
Age	295	1.0	0.981 - 1.022
BMI	295	0.95	0.885 - 1.026

Q0: Dose values between 0 and 25 % quartile; Q1: Dose values between 25 % quartile and Median; Q2: Dose values between Median and 75 % quartile; Q3: Dose values > 75 % quartile.

Table 7. Odds ratios with 95 % confidence interval for neck pain last 12 months at baseline.

	N	OR	95 % CI
Dose 1			
Q1/Q0	302	1.3	0.652 - 2.507
Q2/Q0	302	1.2	0.582 - 2.583
Q3/Q0	302	1.7	0.727 - 4.183
Age	302	1.0	0.970 - 1.021
Dose 3			
Q1/Q0	302	1,0	0.493 - 1.868
Q2/Q0	302	1.6	0.779 - 3.449
Q3/Q0	302	1.2	0.560 - 2.725
Age	302	1.0	0.975 - 1.022
Dose 14			
Q1/Q0	302	1.4	0.736 - 2.778
Q2/Q0	302	1.2	0.623 - 2.507
Q3/Q0	302	0.9	0.431 - 1.712
Age	302	1.0	0.986 - 1.024

Q0: Dose values between 0 and 25 % quartile; Q1: Dose values between 25 % quartile and Median; Q2: Dose values between Median and 75 % quartile; Q3: Dose values > 75 % quartile.

Table 8. Odds ratios with 95 % confidence interval for shoulder pain last 12 months at baseline.

	N	OR	95 % CI
Dose 1			
Q1/Q0	302	1.5	0.759 - 3.062
Q2/Q0	302	1.3	0.596 - 2.800
Q3/Q0	302	1.4	0.575 - 3.451
Age	302	1.0	0.978 - 1.031
Dose 3			
Q1/Q0	302	1.2	0.597 - 2.347
Q2/Q0	302	0.9	0.427 - 1.957
Q3/Q0	302	1.2	0.531 - 2.659
Age	302	1.0	0.983 - 1.032
Dose 14			
Q1/Q0	302	1.4	0.706 - 2.726
Q2/Q0	302	1.1	0.527 - 2.205
Q3/Q0	302	0.9	0.426 - 1.795
Age	302	1.0	0.989 - 1.028

Q0: Dose values between 0 and 25 % quartile; Q1: Dose values between 25 % quartile and Median; Q2: Dose values between Median and 75 % quartile; Q3: Dose values > 75 % quartile.

1.2.2 Follow-up study

Table 9 provides a summary of obtained data for the follow-up investigation including prevalence of musculoskeletal symptoms in the neck, shoulder, and low back (the last 7 days, the last 12 months), and the VAS score for the musculoskeletal pains at the various body locations and the Roland Morris score in the cross-sectional survey of the study population.

Table 9.: Population summary for the follow-up study.

Population	**SWEDISH FORESTRY VEHICLE DRIVERS**				
Number exposed	225				
Vehicles	Harwarder	Forwarder	Mounder	Snowmobile	4 wheeler
From WBV dose calculation (m/s^2 r.m.s):					
Average $a_{x,w}$	0.25	0.5	0.7	0.7	0.7
Average $a_{y,w}$	0.4	0.8	1.1	0.7	0.7
Average $a_{z,w}$	0.3	0.6	0.6	0.8	0.8
Number indicated driving	141	102	6	11	1
Average daily duration (minutes)					
SD daily duration					
Max daily duration					
Min daily duration					
Average years of exposure for all vehicles					
SD years of exposure for all vehicles					
Max years of exposure for all vehicles					
Min years of exposure for all vehicles					
From questionnaire (symptoms):					
% with low back pain in last 7 days					26.9 %
% with low back pain in last 12 months					53.4 %
VAS score for lower back					3.25/10
% with neck pain in last 7 days					32.3 %
% with neck pain in last 12 months					52.9 %
VAS score for neck pain					3.65/10
% with shoulder pain in last 7 days					24.7 %
% with shoulder pain in last 12 months					39.9 %
VAS score for shoulder pain					3.79/10

1.2.3 Comparison of results from baseline and follow-up

Tables 10-12 show prevalence of low-back, neck and shoulder pain developed during the follow-up period (i.e. no case at base line but case at follow-up) or remaining symptoms at follow-up (i.e. case at base-line and still remaining a case at follow-up) in relation to vibration doses 1, 3 and 14.

Table 10. Prevalence of low back pain.

Low back pain last 12 months					
Baseline	*N*	**%**	**%**	**%**	**%**
Dose1		<12928	12928 - 27063	27063 - 44694	>44694
0	*89*	35	43	35	12
1	*124*	67	68	87	76
Dose3		<11216	11216 - 22779	22779 - 48673	>48673
0	*89*	30	30	41	21
1	*124*	63	88	75	68
Dose14		<0.7253	0.7253 - 0.9363	0.9363 - 1.3810	>1.3810
0	*89*	39	33	15	38
1	*124*	64	86	71	67

Table 11. Prevalences of neck pain.

Neck pain last 12 months					
Baseline	*N*	**%**	**%**	**%**	**%**
Dose1		<12928	12928 - 27063	27063 - 44694	>44694
0	*93*	35	30	25	20
1	*121*	75	66	81	82
Dose3		<11216	11216 - 22779	22779 - 48673	>48673
0	*93*	35	27	25	25
1	*121*	54	88	76	86
Dose14		<0.7253	0.7253 - 0.9363	0.9363 - 1.3810	>1.3810
0	*93*	25	18	35	35
1	*121*	70	72	77	85

Table 12. Prevalences of shoulder pain.

Shoulder pain last 12 months					
Baseline	*N*	**%**	**%**	**%**	**%**
Dose1		<12928	12928 - 27063	27063 - 44694	>44694
0	*122*	25	21	32	24
1	*93*	50	62	67	68
Dose3		<11216	11216 - 22779	22779 - 48673	>48673
0	*122*	25	27	28	21
1	*93*	47	73	59	65
Dose14		<0.7253	0.7253 - 0.9363	0.9363 - 1.3810	>1.3810
0	*122*	35	26	19	24
1	*93*	50	73	65	50

Table 13. Risk (odds ratio) of contracting symptoms of low-back-. shoulder- or neck-pain at follow up related to being a case (baseline=1) or not being a case (baseline = 0) at baseline and contrasted in relation to vibration exposure (Q0=minimum value-25 percentile of dose. Q1=25 to 50 percentile of dose. Q2=50 to 75 percentile of dose. Q3=75 percentile to maximum value of dose).

Low back pain (last 12 months)				
	Baseline=0		**Baseline=1**	
	OR	**95% CI**	**OR**	**95% CI**
Dose 1	*N=84*		*N=113*	
Q1/Q0	0.68	0.156 - 2.98	1.3	0.369 - 4.30
Q2/Q0	0.15	0.021 - 1.02	4.1	0.947 - 17.78
Q3/Q0	0.01	0.001 - 0.152	1.6	0.371 - 7.32
Age	1.1	1.04 - 1.22	0.97	0.924 - 1.02
BMI	0.90	0.742 - 1.08	1.2	1.03 - 1.49
Dose 3	*N=84*		*N=113*	
Q1/Q0	1.1	0.246 - 4.58	3.5	0.850 - 14.70
Q2/Q0	1.4	0.290 - 6.83	2.5	0.580 - 10.53
Q3/Q0	0.57	0.090 - 3.58	1.5	0.367 - 6.18
Age	1.0	0.960 - 1.07	0.97	0.926 - 1.02
Bmi	0.96	0.809 - 1.13	1.2	0.984 - 1.40
Dose 14	*N=84*		*N=113*	
Q1/Q0	0.60	0.126 - 2.90	2.6	0.723 - 9.00
Q2/Q0	0.31	0.059 - 1.62	1.5	0.452 - 5.08
Q3/Q0	1.0	0.237 - 4.52	1.0	0.279 - 3.98
Age	1.0	0.969 - 1.06	0.98	0.943 - 1.02
Bmi	0.95	0.808 - 1.12	1.2	0.991 - 1.42

Table 13. *Cont.*

Neck pain (last 12 months)				
	Baseline=0		**Baseline=1**	
	OR	**95% CI**		**OR**
Dose 1	*N=90*		*N=112*	
Q1/Q0	1.1	0.281 - 3.95	0.73	0.202 - 2.62
Q2/Q0	0.74	0.166 - 3.34	1.3	0.277 - 6.38
Q3/Q0	0.84	0.125 - 5.61	1.5	0.245 - 8.78
Age	1.0	0.834 - 1.25	1.0	0.896 - 1.20
Dose 3	*N=90*		*N=117*	
Q1/Q0	0.84	0.235 - 3.01	9.0	1.82 - 44.09
Q2/Q0	1.0	0.237 - 4.50	4.9	1.04 - 22.96
Q3/Q0	1.3	0.254 - 6.77	9.2	1.67 - 50.78
Age	0.97	0.924 - 1.02	0.97	0.916 - 1.02
Dose 14	*N=90*		*N=117*	
Q1/Q0	0.68	0.128 - 3.54	1.1	0.345 - 3.70
Q2/Q0	2.1	0.467 - 9.72	1.6	0.424 - 5.71
Q3/Q0	1.9	0.399 - 8.92	2.1	0.523 - 8.70
Age	0.98	0.941 - 1.02	1.0	0.975 - 1.06
Shoulder pain (last 12 months)				
	Baseline=0		**Baseline=1**	
	OR	**95% CI**	**OR**	**95% CI**
Dose 1	*N=119*		*N=89*	
Q1/Q0	1.1	0.290 - 4.26	1.6	0.419 - 5.81
Q2/Q0	1.9	0.459 - 7.52	1.8	0.399 - 7.83
Q3/Q0	1.6	0.258 - 9.42	1.9	0.378 - 9.38
Age	0.99	0.936 - 1.05	1.0	0.952 - 1.05
Dose 3	*N=119*		*N=89*	
Q1/Q0	1.1	0.307 - 3.70	3.0	0.757 - 12.07
Q2/Q0	1.1	0.319 - 4.07	1.4	0.269 - 6.90
Q3/Q0	0.85	0.181 - 3.99	1.7	0.369 - 8.07
Age	1.0	0.959 - 1.05	1.0	0.955 - 1.06
Dose 14	*N=119*		*N=89*	
Q1/Q0	0.65	0.195 - 2.18	2.9	0.822 - 10.47
Q2/Q0	0.51	0.144 - 1.82	2.3	0.618 - 8.89
Q3/Q0	0.60	0.176 - 2.05	0.86	0.218 - 3.43
Age	1.0	0.966 - 1.04	1.0	0.968 - 1.05

Table 14 displays The Roland Morris disability score at follow-up in relation to the given rating at baseline.

Table 14. Disability change given as prevalence (%) at baseline and follow-up based on the Roland Morris disability scale.
(Categories 1 to 5 represents 0-5. 6-10. 11-15. 16-20 and 21-24 respectively).

		Follow-up				
Baseline		1	2	3	4	5
	1	58.9	12.5	1.8	0	0
	2	8.9	0	7.1	0	0
	3	1.8	3.6	3.6	0	0
	4	1.8	0	0	0	0
	5	0	0	0	0	0

Tables 15 to 17 displays pain rating in a visual analog scale for low-back, shoulder and neck pain.

Table 15. Visual analog pain rating of low-back pain given as prevalences (%) at baseline and follow-up based on the VAS-scale.
(Categories 1 to 4 represent 0-2. 3-5. 6-8. and 9-10 respectively).

		Follow-up			
Baseline		1	2	3	4
	1	13.3	15.6	0	0
	2	17.8	33.3	2.2	0
	3	4.4	8.9	4.4	0
	4	0	0	0	0

Table 16. Visual analog pain rating of neck-pain given as prevalences at baseline and follow-up based on the VAS-scale.
(Categories 1 to 4 represent 0-2. 3-5. 6-8. and 9-10 respectively).

	Follow-up				
Baseline		1	2	3	4
	1	9.8	5.9	2.0	0
	2	3.9	43.1	5.9	0
	3	3.9	9.8	15.7	0
	4	0	0	0	0

Table 17. Visual analog pain rating of shoulder pain given as prevalences (%) at baseline and follow-up based on the VAS-scale.
(Categories 1 to 4 represent 0-2. 3-5. 6-8. and 9-10 respectively).

		Follow-up			
Baseline		1	2	3	4
	1	11.8	5.9	0	0
	2	5.9	38.2	11.8	0
	3	0	17.7	8.8	0
	4	0	0	0	0

Tables 18 to 20 display the change in sick-leave due to low-back, neck and shoulder pain. Table 18 shows that 84% of the subjects with low-back pain have not changed their status of sick-leave. Six percent have changed from not being at sick leave more than 1 day to being away from work. Ten percent have been away more than one day the year before baseline but have not been on sick-leave more than 1 day at follow-up.

Table 18. Prevalence (%) of subjects with sick-leave more than one day. due to low-back pain. during the previous 12-month period in relation to the status at baseline.

	Follow-up		
Baseline		< 1	> 1
	< 1	75.3	5.6
	> 1	10.1	9.0

Table 19 shows that 91.3% of subjects with neck-pain have unchanged status. 3.3% have changed from not being on sick-leave to more than one day. 5.4% have changed from being on sick-leave at baseline but not at follow-up.

The result in Table 20 reveals that 87.5% of subjects with shoulder pain have unchanged status. 3.6% have changed from not being on sick-leave more than one day/12 month to more than one day.

Table 19. Prevalence (%) of subjects with sick-leave more than one day. due to neck-pain. during the previous 12-month period in relation to the status at baseline.

		Follow-up	
		< 1	> 1
Baseline	< 1	84.8	3.3
	> 1	5.4	6.5

Table 20. Prevalence (%) of subjects with sick-leave more than one day. due to shoulder pain. during the previous 12-month period in relation to the status at baseline.

		Follow-up	
		< 1	> 1
Baseline	< 1	82.1	3.6
	> 1	8.9	5.4

1.3 Discussion

The over all 7-day period-prevalence (the last 7 days) of musculoskeletal symptom in the neck, shoulder and low back was in the cross-sectional survey of the study population 28.1%, 26.1% and 32.2% respectively. The 12-month period-prevalence was highest for low back pain (58.1%) followed by neck pain (54.3%) and shoulder pain (39.6%). A similar pattern was also found when the results was analysed in relation to vibration exposure. The risk of contracting symptoms was in no case significant but was slightly increased for shoulder symptoms (1.4) for the last 7-days period. The VAS scores for the musculoskeletal pains were only moderately increased and of comparable magnitude that is 3.3, 3.8 and 3.9 for low back pain, neck pain and shoulder pain. The Roland Morris disability score was 3.8 (out of 24).

When comparing the Roland-Morris score results between the cross-sectional and follow up survey the mean values were comparable but for individual cases a change of low values toward higher values and a corresponding change from higher values towards lower could be noticed and could possibly be interpreted as a regression towards the mean. A similar pattern was revealed for the VAS pain ratings. The VAS ratings for neck pain tended to remain at the same magnitude in a larger extent then for shoulder and low back pain.

When comparing the metrics of vibration exposure according to the protocol for dose calculations the mean results of 8-hour equivalent exposure (dose 14) from the vibration exposed group was higher (1.0 m/s^2) than the present action level given by the EU-directive but below the limit value. The mean exposure duration was 19 years (dose 3) in the study population group. The analysis performed so far does not permit comparisons of and evaluations of the various exposure doses.

No exposure-response (for symptoms) or dose-effect (for score results) relationships at the cross-sectional survey were found. Although no significant risk were revealed for low-back pain, shoulder pain or neck pain a slight risk of 1.2 to 1.7 was found for neck pain and 1.3 to 1.5 for shoulder pain for vibration dose 1. Increasing the contrasts of exposure did not result in a consistent pattern of dose-response.

The possible exposure-response (for symptoms) or dose-effect (for score test results) relation for the changes in the outcomes over time during the follow up period showed that despite mainly “non-significant” findings and wide confidence intervals a consistent pattern was found where subjects with symptoms at base line had increased risk for symptoms at follow-up. This holds for low back, neck and shoulder pain. For vibration Dose3, a significant risk of 4.9 to 9.2 for remaining neck pain was found. Confidence intervals were wide indicating few cases and collapsed models.

Work ability information, based on the question “How much time did you have to take off work due to back/leg pain, neck pain and shoulder pain” in the cross-sectional studies and the results from a change at follow-up revealed that most subjects remained in the same category of workability (84% for low back-pain 91% for neck pain and 88% for shoulder pain.

The major bias of the results is due to varying and low participation rates. In the follow-up analysis additional subjects will be added from slow responders. Due to the large number of questions the risk for missing responses and interconnected responses demands additional analysis in order to reduce missing values.

1.4 Conclusion

The overall conclusion that can be drawn on the basis of the preliminary baseline and follow-up results are that any relation between prevalence of different symptoms and cumulated hours of exposure to WBV in forestry vehicles can not be stated. A consistent finding was that subjects that were “diseased” at base line revealed an increased risk of being “diseased”

also at follow-up. For neck pain significant risks were found for dose 3. The wide confidence intervals indicate unstable models.

Further analysis of collected questionnaire data for the Swedish forestry machine driver population is ongoing and further results will be presented within the project. In addition, this data and corresponding data for the WBV exposed populations in Italy, Netherlands and United Kingdom has been merged as an activity within WP4. Some results from the analysis of merged data are presented in VIBRISKS document D17 and Annex 20 to the final project report.