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CHANGES IN WORKING CONDITIONS AND HEALTH AMONG DAIRY FARMERS IN SOUTHERN SWEDEN. A 14-YEAR FOLLOW-UP

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Pinzke S: Changes in working conditions and health among dairy farmers in southern Sweden. A 14-year follow-up. *Ann Agric Environ Med* 2003, **10**, 185–195.

Abstract: The objective of this study was to describe and analyse the changes in working conditions and health among dairy farmers in Scania in southern Sweden during the period 1988–2002 by a repeat of a mail-in survey. Altogether, 83% of the male and 90% of the female dairy farmers reported some kind of symptoms in the musculoskeletal system during the 12 months prior to the 2002 questionnaire. This is an increase compared to the farmers in 1988. The highest significant changes were an increase of symptoms in the shoulder, neck and in the wrists/hands. The milkers reported most often incidental as well as persistent symptoms in the shoulders. The frequency of hip symptoms was significantly higher among those male milkers who had quit milking during the interim than for the active milkers in 1988. The milkers studied in 2002 had, on average, increased their working time per week, increased the number of cows milked as well as the use of more milking units. In 1988, almost all the milkers studied were working in tethering systems while in 2002 more than one quarter were working in loose-housing systems. The opinion among most of the farmers, both in 1988 and in 2002, regardless of age or sex, was that silage handling and the milking procedure were the most strenuous work operations. On the other hand, the milkers obtained their greatest pleasure from the actual milking job as well as from their work to promote the welfare of the animals. Unprofitability and great investment demands had a bearing on the retirement of milkers but, on the other hand, a high potential of the milkers could have continued 10–15 more years as dairy farmers if the work conditions had been better, e.g. associated with fewer health problems. Apart from the need for developing technical devices to facilitate the milking operation, further research is needed concerning the dairy farmers' well-being and quality of life, perceived stress, and leisure time activities and how these and similar factors influence the prevalence of musculoskeletal symptoms. Strategies for preventive and intervention measures must consider physical workplace factors as well as personal and lifestyle characteristics.

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INTRODUCTION

During the last decade the intensive rationalisation of dairy farming in Sweden has accelerated. The number of milk producers has decreased by a third and the individual farmer has to take care of more and more animals. The biggest dairy farms (both in number and percentage) are to be found in the province of Scania in southern Sweden. From 1990–2000 the number of milk cow stocks in Scania with more than 75 animals increased from 76 to 130 while the total number of dairy farms in Scania decreased from 2,718 to 1,198 [23, 24]. The work tempo

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tended to increase and the machine equipment was becoming more and more technically complicated and costly. This process probably resulted in a changed pattern concerning the work situation and the individual's exposure to risk factors. It is therefore mandatory that we learn more about these issues in order to develop effective strategies for preventive and interventional measures in the working environment of the dairy farmer.

Many studies from several countries around the world have shown that farming is a highly demanding occupation with a variety of daily work tasks that can cause musculoskeletal disorders and work disability. The work operations often involve lifting heavy objects, moving and carrying equipment, and awkward working postures, all risk factors for back injuries and other musculoskeletal problems [1, 15, 17, 18]. Several studies at the Division of Work Science in Alnarp, Sweden, have addressed the working environment problems in dairy barns [6, 7, 13, 14, 30].

A screening of musculoskeletal problems in Swedish dairy farmers was carried out in 1988/89 using information on self-reported symptoms, personal characteristics and work conditions collected in a comprehensive mail-in survey [8]. The study constituted 3,000 participants from three selected geographical regions in southern, central and northern Sweden. The study of the southern region, i.e. the province of Scania, was performed in 1988 while the other two regions were studied in 1989. In all, 82% of the men and 86% of the women reported some kind of symptoms from the musculoskeletal system during the 12 months. Compared to reference data from other occupations [10], pain and discomfort among dairy farmers were reported to be especially frequent in the shoulders, elbows, lower back, hips and knees. In addition, the females reported severe problems with the wrists/hands; this had also been shown in other studies, among them Stål *et al.* [28, 29]. The result of the analyses showed several risk factors for developing musculoskeletal disorders. Individual factors, such as sex, age, weight, as well as those related to work organisation and the physical work place, for example, number of hours worked per week, number of milking units used, the age of the farm building, had significant impact on the reported frequency of symptoms in different parts of the body.

The aim of this present study was, in the first place, to repeat the previous survey from 1988 of the same population in Scania in southern Sweden using the same method for the collection of data on perceived musculoskeletal symptoms, individual conditions and work situation. Thus, the aim was to study the effects of an additional 14 years of exposure to the work environment typical for milk production in southern Sweden on a large number of men as well as women active in this environment. Moreover, the extent of and the reason for retirement during the last decade was to be analysed. The aim was also to describe all active dairy milkers in Scania in 2002 and compare them with the milkers in Scania in 1988. Furthermore, the intention was to make a special study of some of those individuals who had entered into Scanian milk production after 1988 - named here "new-entries". This was to cover milkers who had not taken part in the 1988 study.

MATERIALS AND METHODS

Sample. The main study from 1988 consisted of 1,465 individuals (1,077 males, 388 females) from 1,058 randomly selected dairy farms in Scania. In the present study, these individuals constitute the "base line" group. We know the identity numbers of 545 of the 1,058 farms and the names of the owners. This group constitutes the farms for the follow-up study. The identity numbers and the names of the owners were compared with the register from the local livestock association in Scania that contained the names and addresses of the dairy farmers and farms that were active in 2002. The 545 farms were divided into three groups: group 1 ("non-active"), 153 farms, i.e. those that were not in the register and considered to have quit milk production, group 2 ("new owner"), 153 farms; i.e. farms which were in the actual register but with other owners, and group 3 ("follow-up"), 239 farms, i.e. those farms which were in the actual register, with the same owners and considered to have been active farmers ever since the main study. Thus, group 3 constituted the follow-up group. The rest of the farms remaining in the register after groups 2 and 3 had been picked out formed a fourth group. This group of 368 farms, group 4 (the "rest"), thus consists of farmers who were active in 2002 but not included in the main study undertaken in 1988. Group 4 (the "rest") comprises both farmers who were active 14 years ago and "new-entries" into milk production. By merging groups 2, 3 and 4 together a fifth group was

Table 1. Number of farms and farmers to which the questionnaires were sent, response rates and the number of samples after final classification.

	"non-active"		"follow-up"		"new owner"		"rest"		"all active"	
	farms	farmers	farms	farmers	farms	farmers	farms	farmers	farms	farmers
Sent out	153		239		153		368		760	
Returned	127	127	180	240	94	133	237	327	511	700
Response rate (%)	83		75		61		64		67	
Final samples	142[1]	142[1]	220[2]	266	57[3]	78[3]	258	347	504	686

[1] Includes 51 answers from farms and farmers from the "new owner" group; [2] 21 farms are also included in the "rest" group; [3] 10 farms and 5 farmers are also included in the "follow-up" group.

Table 2. Description of the dairy farmers in the different study groups and their work situation in 1988 compared to 2002. Descriptive values (n, mean, standard deviation (sd) and range) are divided by sex (males - m, females - f). Only male data is presented for the "non-active" group.

		Age (year)		No. of years as a dairy farmer		Hours worked per week		Body weight (kg)		Body height (cm)		Body Mass Index (kg/m^2)		No. of cows milked		No. of milking units	
		m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f
"all active" 2002	n	493	188	494	186	490	187	492	178	490	183	488	177	492	188	481	173
	mean[1]	49.4[c]	47.3	26.6[d]	20.6	40.7[d]	33.9	82.0[d]	69.5	179.6[d]	166.9	25.4	25.0	55.7	59.2	6.6	6.8
	sd	11.00	10.60	12.21	10.83	14.58	13.10	10.70	10.75	6.79	5.72	2.95	3.77	44.16	47.23	4.32	4.34
	range	20–79	20–68	1–55	2–57	2–112	4–70	58–135	45–100	152–200	150–185	18.2–41.7	17.6–39.1	3–320	12–320	1–32	1–24
"base line" 1988	n	1077	388	1074	386	1066	379	1067	377	1069	382	1065	375	1077	386	1057	378
	mean[1]	47.7[c]	45.8	26.1[d]	21.3	36.3[d]	27.7	79.4[d]	65.6	177.7[d]	165.4	25.1[d]	24.0	30.1	29.3	3.7	3.6
	sd	11.89	10.89	14.16	13.42	12.39	10.86	9.91	8.77	6.46	5.81	2.76	2.97	24.74	17.98	2.10	1.43
	range[2]	15–81[c]	19–75	1–65	1–50	4–85[d]	3–88[d]	42–122[d]	50–100[d]	150–205[d]	150–182[c]	17.0–36.8[a]	17.9–34.6[c]	2–300[d]	1–160[d]	1–20[d]	1–14[d]
"non–active" 1988	n	139		138		136		138		138		138		139		135	
	mean	51.5		30.4		34.3		78.8		177.1		25.1		28.0		3.7	
	sd	11.68		13.72		11.84		10.36		5.87		2.97		20.30		2.31	
	range[3]	20–69[d]		2–50[c]		5–85[a]		56–106		163–198		18.7–36.3		3–170		1–20	
"follow–up" 2002	n	205	61	205	58	203	60	204	56	203	59	202	58	205	61	197	56
	mean[1]	54.8[a]	52.6	32.0[c]	26.8	39.5[a]	36.2	81.2[d]	69.4	178.7[d]	166.8	24.7	24.0	45.4	48.4	5.5	5.5
	sd	7.87	7.78	10.21	9.62	13.84	12.39	10.37	9.16	6.94	5.97	2.62	3.01	29.79	28.61	3.17	3.21
	range	37–79	36–68	14–55	14–57	2–80	10–70	58–115	50–90	152–200	150–181	19.3–33.8	18.4–31.6	3–220	12–120	1–20	2–16
„follow up" 1988	n	205	61	205	61	203	59	204	60	204	60	203	60	205	61	203	59
	mean[1]	40.8[a]	38.6	18.9	13.5	38.0[d]	30.6	78.8[d]	66.8	179.0[d]	166.6	24.6	24.0	33.0	33.5	4.0	3.9
	sd	7.87	7.78	10.36	9.12	12.45	10.51	9.47	8.74	6.74	5.71	2.52	2.91	18.86	13.54	2.06	1.00
	range[4]	23–65[d]	22–54[d]	1–45[d]	1–36[d]	4–70	7–60[c]	55–115[d]	52–90[d]	160–202	155–181	19.5–33.8[a]	18.7–29.8	10–200[d]	9–85[d]	1–20[d]	2–6[d]

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$; [1] Differences between sexes (Independent-samples *t*-test); [2] Differences between the "all active" group 2002 and the "base line" group 1988 (Independent-samples *t*-test); [3] Differences between the "non-active" group 1988 and the "base line" group 1988 (Independent-samples *t*-test); [4] Differences between the "follow-up" group 2002 and 1988 (Paired-samples *t*-test).

formed, group 5 ("all active"), which constituted all farmers in Scania who were active in 2002.

A questionnaire with two questions: "What is the reason why you quit milking cows?" and "What is your present employment?" was sent to the "non-active" group. The "follow-up" and the "rest" groups received the same questionnaires that were sent to the main study 14 years previously. They comprised both the standardised Nordic Musculoskeletal Questionnaires [12] and a set of additional questions regarding such items as the number of cows milked per day, the milking system used, degree of mechanisation of the work, which work operation the respondents considered to be the most strenuous, and which gave the best job satisfaction.

The "new owner" group also received the same questionnaires as those sent to the "follow-up" and "rest" groups, but with one additional question: "Why did the former owner hand over ownership?"

Group 1 received one copy of the questionnaires while two copies were sent to groups 2, 3 and 4. All the questionnaires were sent out in December 2001 and January 2002.

Table 1 shows the number of farms to which the questionnaires were sent and the response rates after one reminder. This table also shows the number of the final samples in the five groups after the uncompleted questionnaires had been removed. Some completed questionnaires were also classified as belonging to other groups than their original one. The response rate for the four questionnaires taken together was 70% and for each separate group, "non-active", "follow-up", "new owner" and "rest" the response rate was 83%, 75%, 61%, 64%, respectively (Tab. 1).

Data analysis. The descriptions of the potential risk factors for perceived symptoms in the replies to the

Table 3. Description of the dairy farmers in the different study groups and their work situation in 1988 compared to 2002. Frequency values (n and %) are divided by sex. Only male data is presented for the "non-active" group.

Parameters			"all active"		"base line"		"non-active"		"follow-up"			
			2002		1988		1988		2002		1988	
			n	%	n	%[1]	n	%[2]	n	%	n	%[3]
Employment	males	Employed	29	6.1	45	4.2	8	5.8	8	1.0	4	2.0
		Self-employed	446	93.9	1032	95.8	131	94.2	194	99.0	201	98.0
	females	Employed	28	15.5	10	2.6[d]						
		Self-employed	153	84.5	378	97.5			57	100.0	61	100.0
Handed	males	Right	445	89.9	994	92.3	127	91.4	190	92.7	190	92.7
		Left	38	7.7	68	6.3	10	7.2	10	4.9	12	5.9
		Ambidextrous	12	2.4	15	1.4	2	1.4	5	2.4	3	1.5
	females	Right	176	92.6	359	92.5			56	91.8	58	95.1
		Left	11	5.8	21	5.4			3	4.9	1	1.6
		Ambidextrous	3	1.6	8	2.1			2	3.3	2	3.3
System	males	Tethering	365	74.0	1032	95.8[d]	131	94.2	165	80.5	197	96.1[d]
		Loose-housing	115	23.3	24	2.2	2	1.4	34	16.6	6	2.9
		Both	13	2.6	21	1.9	6	4.3	6	2.9	2	1.0
	females	Tethering	135	71.4	381	98.2[d]			47	77.0	60	98.4[c]
		Loose-housing	46	24.3	3	0.8			12	19.7	1	1.6
		Both	8	4.2	4	1.0			2	3.3		
Building year	males	-1969	31	6.4	332	31.2[d]	54	39.1[b]	15	7.3	39	19.1[d]
		1970-1979	117	24.0	491	46.2	62	44.9	65	31.7	106	52.0
		1980-1989	110	22.5	240	22.6	22	15.9	42	20.5	59	28.9
		1990-1999	197	40.4					70	34.1		
		2000-	33	6.8					13	6.3		
	females	-1969	11	6.0	104	27.1[d]			3	5.1	10	16.4[d]
		1970-1979	44	23.9	190	49.5			20	33.9	38	62.3
		1980-1989	42	22.8	90	23.4			10	16.9	13	21.3
		1990-1999	72	39.1					22	37.3		
		2000-	15	8.2					4	6.8		

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$; [1] Differences between the "all active" group 2002 and the "base line" group 1988 (Mann-Whitney Test); [2] Differences between the "non-active" group 1988 and the "base line" group 1988 (Mann-Whitney Test); [3] Differences between the "follow-up" group 2002 and 1988 (Wilcoxon Signed-Ranks Test).

questionnaires for the different study groups are shown in Tables 2 and 3. For the statistical analysis of the results, conventional t-tests and χ^2-analyses were used. The probability limits for evaluating statistical tendency and significance were: [a] = $p \leq 0.10$, [b] = $p \leq 0.05$, [c] = $p \leq 0.01$, [d] = $p \leq 0.001$. For the prediction of incidental and persistent symptoms in the different body regions the impact of the potential risk factors was first studied using univariate analysis. Before the relationship was studied, the risk factors were dichotomised around their median values for males and females, respectively. The risk factors that were associated ($p \leq 0.10$) with incidental and persistent symptoms in the univariate analysis were then treated in reverse stepwise multiple logistic regression models, according to Cox [3], Hosmer & Lemeshow [9]. The models were fitted to data using the SPSS programme [22]. The individual associations of the risk factors with the perceived symptoms are presented as odds ratios with 95% confidence intervals.

RESULTS

Both results are presented from the "all active" group and the "non-active" groups compared to the "base line" group. The changes in the "follow-up" group from 1988 to 2002 are described. Furthermore, "new-entries" into dairy farming, e.g. those who have less than 14 years of experience of milking cows are compared to the "new-entries" in 1988.

The "all active" group. The mean age of the male milkers in the "all active" group in 2002 was significantly about 2 years greater than that of the females (49.4 years and 47.3 years, respectively), they had worked for an average of 6 years more than the females as dairy farmers (26.6 years and 20.6 years, respectively), and had worked about 7 hours more per week than their female counterparts (40.7 hours and 33.9 hours, respectively). Both the males and females in the "all active" group in 2002 compared to

the "base line" group in 1988 had a significantly increased average working time with about 4 and 6 hours per week, respectively; their mean body weight was greater, i.e. about 3–4 kg more; their mean height was also greater - about 1–2 cm taller; their mean Body Mass Index was greater - 0.4 and 1.0 kg/m^2, respectively. The number of cows they milked in 2002 had increased from 25 to 30 cows, respectively and they also used about 3 more milking units. The extent of being employed among the females had significantly increased in 2002 compared to 1988 (15.5% and 2.6%, respectively). The extent of working in loose-housing systems had significantly increased (25.9% for males and 28.5% for females in 2002, and 4.1% and 1.8%, respectively in 1988). About 47% of the "all active" farmers had since 1990 been working on newly built farms.

In the "all active" group in 2002, 83.4% of the males and 89.7% of the females reported some kind of symptoms of the musculoskeletal system during the previous 12 months (Tab. 4). This is an increase compared to the male and female dairy farmers in the "base line" group in 1988 (81.2% and 84.2%, respectively). The male farmers in 2002 reported most frequently symptoms in the lower back, shoulders and knees (53.6%, 43.6% and 37.7%, respectively). The females reported most frequently symptoms in the shoulders, lower back, and wrists/hands (55.6%, 46.7% and 46.2%, respectively). In 2002 compared to 1988, both the male and female dairy farmers reported more often problems in all body regions except the lower back and knees where a minor decrease could be seen. The highest significant changes in symptom frequency among both the male and female "all active" dairy farmers in 2002, compared to the "base line" in 1988, were an increase in the shoulder, neck and in the wrists/hands.

The opinion among most farmers, both in 1988 and in 2002, regardless of age or sex, was that tasks of silage handling and of milking were the most strenuous work operations. On the other hand, the milkers reported that they obtained their greatest satisfaction from the actual milking job as well as from their work with the animals to promote their welfare.

The "non-active" group. Only the males were selected when comparing the "non-active" with the "base line" group. The male selection was performed to protect bias in the statistical analysis because there were only 3 females in the "non-active" group.

In Tables 2 and 3 the description is presented of the "non-active" group and their work situation in 1988 compared to the "base line" group. The male dairy milkers who had quit milking were in 1988 significantly older and had worked more years as dairy farmers than the males in the "base line" group, i.e. than all the active male milkers in 1988 (51.5 years and 47.7 years, respectively and 30.4 years and 26.1 years, respectively) (Tab. 2). There was a tendency that they worked fewer hours per week than the milkers in the "base line" group (34.3 hours and 36.3 hours, respectively). The "non-active" milkers also worked in significantly older buildings than the "base line" milkers (Tab. 3). It can be seen from Table 4 that the "non-active" male milkers reported significantly more often symptoms from the hips during the 12 months immediately preceding the

Table 4. Frequency of perceived symptoms (numbers (n) and per cent (%)) in the musculoskeletal system some times during the last 12 months divided by sex among the "all active" group (males=445-476, females=180-185), "base line" group (males=1071-1075, females=386-387) and the "non-active" group (males=137-138, only male data is presented).

		"all active" 2002		"base line" 1988		"non-active" 1988	
		n	%[1]	n	%[1/2]	n	%[3]
Neck	males	139	30.8[b]	229	21.3[c/d]	32	23.2
	females	72	39.1	112	28.9[/b]		
Shoulders	males	198	43.6[c]	366	34.0[c, d]	51	37.0
	females	107	58.8	166	42.9[/d]		
Elbows	males	93	20.4[b]	189	17.6[b]	23	16.7
	females	50	27.8	87	22.5		
Wrists/hands	males	111	24.3[d]	172	16.0[d/d]	28	20.3
	females	85	46.2	131	33.9[/c]		
Upper back	males	51	11.5	91	8.5[b/a]	13	9.5
	females	28	15.2	47	12.2		
Lower back	males	247	53.6	594	55.5[b]	75	54.3
	females	86	46.7	188	48.6		
Hips	males	124	27.6[a]	271	25.3	47	34.1[c]
	females	63	34.4	100	25.8[/b]		
Knees	males	174	37.7	429	40.0	57	41.3
	females	61	33.2	145	37.5		
Feet	males	65	14.3	113	10.5[c/b]	20	14.5
	females	36	19.6	60	15.5		
In any	males	397	83.4[b]	872	81.2	112	81.2
	females	166	89.7	326	84.2[/a]		

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$; [1] Differences between sexes (Independent-samples *t*-test); [2] Differences between the "all-active" group 2002 and the "base line" group 1988 (Mann-Whitney U Test); [3] Differences between the "non-active" group 1988 and the "base line" group 1988 (Mann-Whitney U Test).

Table 5. Frequency of answers to the questions "What is the reason why you quit milking cows?" and "What is your present employment?". The mean age in 2002 for each group of answers and the differences in age compared to the mean age of the whole "non-active" group (65.5 years) are also presented.

	Reason	n	%	mean age
Reason (n = 142)	Age	78	54.9	71.2[d]
	Work-related health problem	29	20.4	62.4
	Other	55	38.7	58.8[d]
Present employment (n = 91)	Pensioner	44	48.4	71.3[d]
	Farmer, but quit milking	37	40.7	60.3[b]
	Other activity	23	25.3	53.7[d]

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$.

Table 6. Frequency of symptoms (n, per cent) in the musculoskeletal system at some time during the last 12 months among the same dairy farmers in Scania, the changes in symptoms (n, per cent) and the significance level (p) of the changes before and after 14 year follow-up. N = 245-256, males = 185-195, females = 58-61.

		N	Symptoms 2002		Symptoms 1988		Symptoms 1988/2002							
							No/No		No/Yes		Yes/No		Yes/Yes	
			n	%	n	%	n	%[1]	n	%[1]	n	%[2]	n	%[2]
Neck	Male	191	67	35.0	41	21.4[d]	110	73.3	40	26.7	14	34.1	27	65.9
	Female	61	23	37.7	17	27.9	33	75.0	11	25.0	5	29.4	12	70.6
	Total	252	90	35.7	58	23.0[d]	143	73.7	51	26.3	19	32.8	39	67.2
Shoulders	Male	187	92	49.2	54	28.9[d]	84	63.2	49	36.8	11	20.4	43	79.6
	Female	59	41	69.5	25	42.5[c]	13	38.2	21	61.8	5	20.0	20	80.0
	Total	246	133	54.1	79	32.1[d]	97	58.1	70	41.9	16	20.3	63	79.7
Elbows	Male	189	54	28.5	25	13.2[d]	122	74.4	42	25.6	13	52.0	12	48.0
	Female	58	21	36.2	10	17.2[b]	31	64.6	17	35.4	6	60.0	4	40.0
	Total	247	75	30.4	35	14.2[d]	153	72.2	59	27.8	19	54.3	16	45.7
Hands/wrists	Male	189	47	24.9	27	14.3[c]	129	79.6	33	20.4	13	48.1	14	51.9
	Female	59	31	52.5	23	38.9	18	50.0	18	50.0	10	43.5	13	56.5
	Total	248	78	31.5	50	20.2[c]	147	74.2	51	25.8	23	46.0	27	54.0
Upper back	Male	185	18	9.8	10	5.4	161	92.0	14	8.0	6	60.0	4	40.0
	Female	60	12	20.0	7	11.7	45	84.9	8	15.1	3	42.9	4	57.1
	Total	245	30	12.3	17	7.0[b]	206	90.4	22	9.6	9	52.9	8	47.1
Lower back	Male	194	117	60.3	114	58.7	42	52.5	38	47.5	35	30.7	79	69.3
	Female	60	27	45.0	29	48.3	19	61.3	12	38.7	14	48.3	15	51.7
	Total	254	144	56.7	143	56.3	61	55.0	50	45.0	49	34.3	94	65.7
Hips	Male	186	61	32.8	30	16.2[d]	115	73.7	41	26.3	10	33.3	20	66.7
	Female	60	26	43.4	13	21.7[c]	31	66.0	16	34.0	3	23.1	10	76.9
	Total	246	87	35.4	43	17.5[d]	146	71.9	57	28.1	13	30.2	30	69.8
Knees	Male	193	79	40.9	76	39.4	88	75.2	29	24.8	26	34.2	50	65.8
	Female	60	24	40.0	24	40.0	26	72.2	10	27.8	10	41.7	14	58.3
	Total	253	103	40.7	100	39.5	114	74.5	39	25.5	36	36.0	64	64.0
Feet	Male	195	36	18.5	17	8.7[c]	149	83.7	29	16.3	10	58.8	7	41.2
	Female	61	17	27.8	5	8.2[c]	40	71.4	16	28.6	4	80.0	1	20.0
	Total	256	53	20.7	22	8.6[d]	189	80.8	45	19.2	14	63.6	8	36.4

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$; [1] Percentage of those milkers who had no symptoms in 1988; [2] Percentage of those milkers who had symptoms in 1988.

questionnaire than the "base line" male milkers (34.1% and 25.3%, respectively).

Most of the "non-active" milkers (54.9%) reported age as being the reason for quitting milking cows (Tab. 5). These milkers are about 6 years older than the mean age for the group. About 20% stated the reason to be work-related health problems, e.g. asthma, allergy, slip-and-fall accidents, mental ill-health, and musculoskeletal symptoms in the shoulders, hands, back, hips and knees above all. Examples of other reasons for quitting milk production were the possibility to get a "milk pension", unprofitability, old buildings and equipment, great investment demands, and complicated sets of regulations. Most of the "non-active" milkers (48.4%) by 2002 were pensioners and were 6 years older than the mean age for the "non-active" group. About 41% were still farmers but had quit milking. They had changed the production alignment to crops, beef cattle, pigs, vegetables, etc. About 25% were employed in various occupations other than farm work, such as industrial, sheet-metal and saw-mill work, caretaking, work in cemeteries, forestry, etc. These individuals were about 12 years younger than the mean age for the "non-active" group.

The "follow-up" group. From Table 2 can be seen that the male milkers in the "follow-up" group in 2002 were about 2 years older than the females (54.8 years and 52.6 years, respectively). They had worked about 5 years longer as dairy farmers (32.0 years and 26.8 years, respectively) and worked about 3 hours more per week than the females (39.5 hours and 36.2 hours, respectively). Since 1988, the females had increased their working time by about 6 hours. Both the males and females had increased in body weight by about 2.5 kg; they milked 12-15 more cows and used about 1.5 more milking units. Only 3.5% of the male dairy farmers and 1.6% of the females had worked in

Table 7. Description of the "new-entries" work situation in 1988 compared to 2002. The descriptive values (n, mean, standard deviation (sd) and range) are divided by sex.

Parameters		"new-entries" 2002				"new-entries" 1988			
		n	mean[1]	sd	range	n	mean[1]	sd	range[2]
Age (year)	males	85	34.6[a]	8.43	20–60	276	35.2	7.71	15–66
	females	53	37.5	9.59	20–66	153	35.4	7.25	19–60[a]
No. of years as a dairy farmer	males	85	8.6	3.54	1–14	276	7.9[b]	3.32	1–14
	females	54	8.2	3.79	2–14	153	7.1	3.28	1–14[b]
Hours worked per week	males	82	39.2[c]	13.35	10–80	274	35.0[d]	12.27	4–65[c]
	females	54	32.3	12.54	4–70	151	27.9	11.86	3–60[b]
Body weight (kg)	males	85	81.5[d]	8.69	63–100	274	78.6[d]	10.18	42–122[b]
	females	52	68.3	10.34	50–100	148	63.7	8.56	50–100[c]
Body height (cm)	males	85	182.2[d]	6.23	172–198	275	179.2[d]	6.61	157–203[d]
	females	53	167.7	6.14	150–185	149	165.8	5.68	153–181[b]
Body Mass Index (kg/m^2)	males	85	24.5	2.26	19.8–30.1	274	24.5	2.68	17.0–33.6
	females	52	24.3	3.53	17.7–34.6	147	23.1	2.78	17.9–34.6[b]
No. of cows milked	males	84	68.8[a]	54.27	17–320	276	33.9	27.75	6–300[d]
	females	53	87.1	69.67	20–320	153	34.8	22.59	4–160[d]
No. of milking units	males	85	8.1[a]	4.75	2–20	275	4.3	2.78	1–20[d]
	females	47	9.7	5.59	1–24	148	4.1	1.64	1–14[d]

[1] Differences between sexes (Independent-samples *t*-test); [2] Differences between the "new-entries" groups in 2002 and 1988 (Independent-samples *t*-test).

loose-housing systems in 1988. In 2002, the corresponding figures were 19.5% and 23.0%, respectively. More than 40% of the farmers had been working since 1990 in newly-built farms or in buildings that had been extensively renovated.

The males who were still active in 2002 reported most frequently symptoms that had occurred at some time during the previous 12 months in the lower back, shoulders and knees (60.3%, 49.2% and 40.9%, respectively) (Tab. 6). The females reported most frequently symptoms in the shoulders, hands/wrists and lower back (69.5%, 52.5% and 45.0%, respectively). Since 1988, the males had reported more symptoms in the neck, shoulders, elbows, hands/wrists, hips and feet, with the greatest increase in the shoulders and hips (from 28.9% and 16.2% in 1988 to 49.2% and 32.8% in 2002, respectively). The females reported more symptoms in the shoulders, elbows, hips, and feet, and the greatest increase was also in the shoulders and hips (from 42.5% and 21.7% in 1988 to 69.5% and 43.4% in 2002, respectively).

Incidence of symptoms. During the 14 years, the females ran a greater risk than the males of musculoskeletal symptoms in all body regions, except for the neck and lower back. Significant differences between females and males were seen for incidental shoulder symptoms (OR 2.8, 95% CI 1.3–6.0), hand symptoms (OR 3.9, 95% CI 1.8–8.3) and for feet symptoms (OR 2.3, 95% CI 1.1–4.6). Those male milkers who had no symptoms in 1988 reported most often symptoms in the lower back and shoulders in 2002 (47.5% and 36.8%, respectively). The females reported the same tendency, most often in the shoulders and hands/wrists (61.8% and 50.0%, respectively).

Risk factors of incidental symptoms. From the univariate and logistic regression analyses (not shown in this paper), it can be concluded that the risk factors listed below had a significant impact on the prediction of incidental symptoms. To be above the median age means for males a significantly decreased risk of incidental neck symptoms (OR 0.4, 95% CI 0.2–0.9), a tendency for an increased risk of knee symptoms (OR 2.2, 95% CI 0.9–5.2), a significantly increased risk of foot symptoms (OR 2.5, 95% CI 1.0–5.9) and for females a significantly decreased risk of elbow symptoms (OR 0.2, 95% CI 0.0–0.9). Similarly, with a value above the median of Body Mass Index there is a decreased risk of male incidental shoulder symptoms (OR 0.4, 95% CI 0.2–0.8). With the number of cows milked above the median value there is an increased risk of elbow symptoms for females (OR 4.0, 95% CI 1.1–15.2). Working with more milking units than the median value means a tendency for females to have an increased incidental risk for elbow symptoms (OR 4.3, 95% CI 0.9–19.9). With left-handedness there is increased risk of incidental upper back symptoms for females (OR 14.7, 95% CI 1.1–187.4). The female dairy farmers had a tendency for an increased risk of incidental knee symptoms if they worked on farms built later than 1980 (OR 10.7, 95% CI 1.0–119.7).

Persistence of symptoms. Compared to the men, the women ran to a greater risk of persistent symptoms in all body regions except for the elbows, lower back, knees and feet. However, a statistical tendency for differences between females and males was seen only for persistent lower back symptoms (OR 0.5, 95% CI 0.2–1.1). Those male milkers who had reported symptoms in 1988, had in

Table 8. Description of the "new-entries" and their work situation in 1988 compared to 2002. The frequency values (n and %) are divided by sex (male - m, females - f).

Parameters			"new-entries" 2002		"new-entries" 1988	
			n	%	n	%[1]
Employment	Employed	m	17	21.0	20	7.2[d]
	Self-employed		64	79.0	2562	92.8
	Employed	f	21	39.6	9	5.9[d]
	Self-employed		32	60.4	144	93.4
Handed	Right	m	75	88.2	261	94.6[b]
	Left		9	10.6	13	4.7
	Ambidextrous		1	1.2	2	0.7
	Right	f	52	96.3	142	92.8
	Left		2	3.7	6	3.9
	Ambidextrous				5	3.3
System	Tethering	m	56	65.9	258	93.5[d]
	Loose-housing		27	31.8	12	4.3
	Both		2	2.4	6	2.2
	Tethering	f	28	51.9	151	98.7[d]
	Loose-housing		22	40.7	1	0.7
	Both		4	7.4	1	0.7
Building year	-1969	m	4	4.8	51	18.6[d]
	1970-1979		11	13.3	119	43.4
	1980-1989		20	24.1	104	38.0
	1990-1999		41	49.4		
	2000-		7	8.4		
	-1969	f	2	3.8	28	18.4[d]
	1970-1979		10	19.2	70	46.1
	1980-1989		8	15.4	54	35.5
	1990-1999		26	50.0		
	2000-		6	11.5		

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$; [1] Differences between the "new-entries" groups 2002 and 1988 (Mann-Whitney Test).

2002 most often persistent symptoms in the shoulders and lower back (79.6% and 69.3%, respectively). The females had most often persistent symptoms in the shoulders and hips (80.0% and 76.9%, respectively).

Risk factors of persistent symptoms. The male dairy farmers had a tendency to a decreased risk of persistent neck symptoms with a body mass index above the median value (OR 0.2, 95% CI 0.0–1.2) and if they worked on farms built later than 1980 (OR 0.2, 95% CI 0.0–1.3). The males ran a significantly decreased risk of persistent hand/wrist symptoms if their body weight exceeded the median value (OR 0.1, 95% CI 0.0–0.7) and the females ran an increased risk with a body height above the median value (OR 6.4, 95% CI 0.9–43.2). The number of milking units above the median value meant a decreased risk of persistent hip symptoms for the male dairy farmers (OR 0.2, 95% CI 0.0–1.2).

The "new-entries" group. Tables 7 and 8 show the description of the "new-entries" and their work situation in 1988 compared to 2002. Thus, the male milkers among the "new-entries" in 2002 were about 3 years younger than the females (34.6 years and 37.5 years, respectively), they worked about 7 hours more per week (39.2 hours and 32.3 hours, respectively) and milked about 17 cows fewer than the females (68.8 cows and 87.1 cows, respectively). Both the male and female "new-entries" in 2002 compared to their counterparts in 1988 had an increased working time of about 4 hours more, had an increased body weight of 3–4 kg more, milked more cows (an increase of 35 and 52 cows, respectively), and also used about 4–6 more milking units. The extent of being employed among both the male and female "new-entries" had significantly increased in 2002 compared to 1988 (21.0% for males and 39.6% for females in 2002, as compared to 7.2% and 5.9%, respectively, in 1988). In addition, the proportion of "new-entries" working in loose-housing systems had significantly increased (34.2% for males and 48.1% for females in 2002, and 6.5% and 1.4%, respectively, in 1988). About 60% of the "new-entries" had been working since 1990 on newly-built farms.

The male "new-entries" in 2002 most frequently reported symptoms occurring at some time during the previous 12 months in the lower back, knees, and shoulders (38.0%, 35.0% and 33.3%, respectively) (Tab. 9). The females most frequently reported symptoms in the shoulders, lower back, and neck (55.6%, 48.1% and 45.3%, respectively). The greatest significant changes in symptom frequency among male "new-entries" in 2002 compared to "new-entries" in 1988 were a decrease in the lower back and an increase in the neck and upper back (from 52.0%, 17.8% and 9.2%, respectively, in 1988 to 38.0%. 28.2% and 18.2, respectively, in 2002). The corresponding significant change for the females was an increase of reported symptoms in the neck (from 17.8% in 1988 to 28.2% in 2002).

DISCUSSION

The "all active" group. The present study shows that in 2002 dairy farmers, compared to farmers 14 years previously, had increased their working time per week, increased the number of cows they milked and also used more milking units. Almost half of the farmers since 1990 were working on newly-built farms or in buildings that had been extensively renovated, for example to change the production system. In 1988, almost all the studied female and male dairy farmers were working in tethering systems while in 2002 more than one quarter were working in loose-housing systems. Both the male and female "all active" farmers in 2002 reported more frequently some kind of symptoms from the musculo-skeletal system than the "base line" farmers in 1988. The greatest significant changes were an increase in reported symptoms in the shoulder, neck and in the wrists/hands.

Table 9. Frequency of symptoms (n, per cent) in the musculoskeletal system at some time during the last 12 months among males and females who had worked less than or the duration of 14 years as dairy farmers in 2002 and 1988, and the significance level (p) of the changes between the two year groups. The group 2002 contains a total number of N=130-135 (males=77-81, females=52-54) and for the group 1988, N=426-428, (males=273-275, females=153).

		Symptoms 2002			Symptoms 1988		
		N	n	%	N	n	%[1]
Neck	Male	78	22	28.2	275	49	17.8[b]
	Female	53	24	45.3	153	44	28.8[b]
	Total	131	46	35.1	428	93	21.7[c]
Shoulders	Male	81	27	33.3	275	82	29.8
	Female	54	30	55.6	153	70	45.8
	Total	135	57	42.2	428	152	35.5
Elbows	Male	79	10	12.7	274	41	15.0
	Female	52	12	23.1	153	24	15.7
	Total	131	22	16.8	427	65	15.2
Hands/wrists	Male	77	20	26.0	274	48	17.5[a]
	Female	53	20	37.7	153	52	34.0
	Total	130	40	30.8	427	100	23.4[a]
Upper back	Male	77	14	18.2	273	25	9.2[b]
	Female	53	7	13.2	153	19	12.4
	Total	130	21	16.2	426	44	10.3[a]
Lower back	Male	79	30	38.0	273	142	52.0[b]
	Female	52	25	48.1	153	68	44.4
	Total	131	55	42.0	426	210	49.3
Hips	Male	79	16	20.3	273	41	15.0
	Female	52	12	23.1	153	29	19.0
	Total	131	28	21.4	426	70	16.4
Knees	Male	80	28	35.0	275	105	38.2
	Female	52	15	28.8	153	46	30.1
	Total	132	43	32.6	428	151	35.3
Feet	Male	79	7	8.9	275	24	8.7
	Female	52	6	11.5	153	15	9.8
	Total	131	13	9.9	428	39	9.1

[a] $p \leq 0.10$, [b] $p \leq 0.05$, [c] $p \leq 0.01$, [d] $p \leq 0.001$; [1] Differences between the "new-entries" groups 2002 and 1988 (Mann-Whitney Test).

This might be explained by the increase of exposure to the risk factors described above, and by the degree of the transition from working in tethering milking systems to loose-housing systems.

Several studies have found higher loads on the upper extremities with respect to hand position, repetitiveness and muscular activity when milking in loose-housing parlour systems compared to the old-fashioned tethering system [26, 27], while other studies show that milking in a loose-housing system decreased the workload on the lower part of the body (e.g. [34]). Pinzke *et al.* [20] identified 3 main work tasks that contained high muscle load values and almost no time for muscular rest during milking in a loose-housing parlour system, i.e. "drying the cow's udder", "pre-milking the first milk" and "attaching the milking unit to the udder". These milking tasks also involved extreme wrist positions and high peak velocities. It was concluded that the high muscle loads in combination with the extreme positions and movements of the hand and forearm might contribute to the development of injuries among milkers.

In order to gain better productivity, new labour-intensive milking systems are being introduced in Sweden. Thus, a type of loose-housing system is rotary milking where the cows walk on to a rotating carousel and the milker does the milking standing in the same place at a level below and inside the carousel. Results from a case study show that the rotary system puts considerable demands on the wrists and hands regarding velocities, repetitiveness and almost no time for rest, with values even higher than those registered in tethering and parlour systems [33]. Values were found close to those described in other repetitive industrial work with a high risk of wrist and hand disorders.

In 2002 compared to 1988, both the male and female dairy farmers more frequently reported symptoms in all body regions except for the lower back and knees where a minor decrease could be seen. Several studies have shown that milking in tied stall systems involves more loading work postures and more handling of manual materials than milking in parlour systems [14, 16]. In tie stall milking the farmer has to squat, kneel or sit when milking the cows, while in parlour milking the worker is able to stand with a straight back as the cows are located on a higher level than the milker. Furthermore, in the tethering systems the farmer has to move all the required milking equipment from one cow to another while in parlour milking the equipment is stationary. The awkward work postures and the amount of handling heavy manual material in the old-fashioned tethering systems which put a big physical load and strain especially on the lower part of the body compared to the work conditions in loose-housing systems may explain the greater frequency of symptoms in the lower back and knees in 1988 compared to the reported symptoms in 2002.

The "follow-up" group. In general, the description of the dairy farmers and their work situation for the "follow-up" group in 1988 and 2002 agreed with the corresponding values for the "all active" group except for the age and number of years as a dairy farmer. In 1988, the farmers in the "follow-up" group were about 7 years younger and had 7 years less experience as a dairy farmer than the "all active" farmers. They were also 5 years older and had 5 years more experience in 2002 than the "all active" farmers in the same year. In 2002, the most reported frequency of symptoms were in the same body regions as for the "all active" group but to a greater degree, which could partly be explained by the age differences between the groups. The females compared to the male milkers in the "follow-up" group ran a significant higher risk for incidental shoulder, hand and foot symptoms and a tendency to a lower risk for

persistent lower back symptoms. The males who had no symptoms in 1988, reported most often symptoms in the lower back and shoulders in 2002. Similarly, the females reported most often symptoms in the shoulders and hands/wrists. The only risk factor found to have significant impact for predicting incidental symptoms in any of these body parts was the Body Mass Index, i.e. to be above the median of Body Mass Index meant a decreased risk of male incidental shoulder symptoms. Those male milkers who had symptoms in 1988, most often had persistent symptoms in the shoulders and lower back in 2002 and the females in the shoulders and hips. None of the studied risk factors had any significant impact for predicting persistent symptoms in any of these body parts. In the present study of the "follow-up" group the exposure data from 1988 was used as a proxy for information for the period 1988–2002 to predict both incidental and persistent symptoms. However, this period of 14 years exposure to the different risk factors may not have been stable for many farmers. Furthermore, symptoms could have emerged and/or disappeared several times since the symptoms are usually reversible (e.g. [21]). These circumstances could be one part of the explanation for the limited number of significant associations between the studied risk factors and incidental or persistent symptoms. Difficulties in detecting existing risk factors hinder the use of negative findings as evidence of no risk, whereas positive findings may be interpreted as strong indications for the existence of real risk factors [5].

The "non-active" group. The frequency of reported male hip symptoms (34%) in the "non-active" group in 1988 is significantly higher than for the male dairy farmers in the "base line" group, and very high compared to reference values of hip symptoms in other male professions. Jonsson [10] classified a frequency of hip symptoms >15% as high based on the symptom frequency of 29 "male" occupations registered in similar surveys. About 20% stated work-related health problems to be the reason why dairy farmers quit milking cows and their hip symptoms was one of the reasons. About one fourth of the farmers who had quit milking were employed in various occupations other than farm work. This study shows that unprofitability and great investment demands have considerable bearing on the retirement of milkers, but on the other hand there was a high potential of "non-active" milkers who could have continued for another 10-15 years as dairy farmers if the work conditions had been better, for example eliciting fewer health problems.

The "new-entries" group. Both the male and female "new-entries" in 2002 compared to their counterparts in 1988 worked significantly more hours per week, milked more cows and used more milking units. About 21% of the males and 40% of the female "new-entries" in 2002 were employed which is a significant increase compared to the "new-entries" in 1988. The male "new-entries" in 2002 most frequently reported symptoms in the lower back, knees, and shoulders, and the females most frequently in the shoulders, lower back, and neck. In some body parts the frequencies of symptoms were even higher than the corresponding figures in the "all active" group in 2002. The highest significant changes in symptom frequency among male "new-entries" in 2002, compared to their counterparts in 1988, were a decrease in the lower back and an increase in the neck and upper back, and for the females an increase of neck symptoms.

This study has clearly shown that in 2002 the studied dairy farmers had increased the number of cows in the herds and consequently increased their working time in milking. The high level of technology available today that permits, for example, computerised fodder calculations and automated feeding procedures, enables the farmer to conduct intensive large-scale husbandry with a large number of animals. Therefore, the farmer now spends more time, for example, in swine and poultry production, performing the same work tasks, thus increasing exposure to work-related health risks [2]. Today, dairy farmers work to a greater extent as employees compared to 14 years ago. The trend towards large-scale and fewer family-operated agricultural businesses is also shown in the official statistics [25]. The extent of working in loose-housing systems has significantly increased during the last 14 years. The described changes of work conditions for the dairy farmers may explain the increased frequency of the reported symptoms in the musculoskeletal system. Therefore, it is necessary to develop new techniques to reduce and prevent the musculoskeletal problems. At the Division of Work Science in Alnarp, Sweden, much effort is spent on facilitating the milking operations in an ergonomic way. Two early examples of such technical improvements are the overhead rail system for tie stall milking [4] and adjustable working height in milking parlours [30]. Other technical improvements include lighter teat cups and cluster units, or attachment of the teat cups to a weight-reducing device [31, 32]. A so-called "automatic washing cup" is under development which will reduce the workload on the upper extremities, especially the wrist and hands during the two strenuous tasks of drying the cow's udder and pre-milking described by Pinzke *et al.* [20].

In Sweden today, it is difficult to recruit qualified people to work on dairy farms. One of several possible explanations for this might be an unsatisfactory working environment. This study has shown that in 2002 the active dairy farmers reported more frequently musculoskeletal problems in several body regions than 14 years ago and that work-related health problems can be a very plausible reason why dairy farmers quit milking cows. Apart from the need of developing technical devices that facilitate the milking operations, further research is required concerning dairy farmers' well-being and quality of life, perceived stress and leisure time activities and how these and similar factors influence the prevalence of musculoskeletal symptoms. Strategies for preventive and

intervention measures must embrace physical workplace factors as well as personal and lifestyle characteristics [19]. At our department, ongoing studies are dealing with the psychosocial working conditions for Swedish dairy farmers and their employees [11]. The authors state that further studies of interest and importance concerning the psychosocial working environment in dairy farming should be based on Human Management - work organisation in relation to work satisfaction.

Thus, there is a need to improve both the physical and the psychosocial working conditions in order to make the job more attractive with fewer health problems for all those who are today active in dairy farming, as well as to recruit new people to work on dairy farms.

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