

Perceived Physical and Psychosocial Exposure and Health Symptoms of Dairy Farm Staff and Possible Associations with Dairy Cow Health

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ABSTRACT. *The aim of this study was to gain a deeper understanding of work-related physical and psychosocial exposure and health symptoms of farm staff working in indoor loose-housing dairy systems in Sweden, and to examine possible associations between exposure and health symptoms of farm staff and disease incidence in their dairy herds. A sample of 41 farm owners or managers and 20 directly employed farm workers participated, each from a Swedish dairy farm with loose-housed cows. Mailed questionnaires comprising 29 questions were used to create four separate indices representing physical exposure, psychosocial exposure, physical symptoms, and psychosocial symptoms. Cow herd incidence rates of common veterinary-reported clinical diseases were calculated based on official records. Partial Spearman rank correlation was used to analyze associations. The study confirmed that physical and psychosocial exposure and health symptoms are not uncommon among owners/managers and employed workers. The study also found that farm owners/managers experience more physical symptoms in dairy herds with lower cow disease incidence rates, while more frequent or intensive exposure to negative psychosocial work environment factors among employed dairy workers is associated with a high herd disease incidence rate.*

Keywords. *Animal health, Dairy cow, Exposure, Farmer, Farm worker, Partial Spearman rank correlation, Physical, Psychosocial, Questionnaire, Symptom.*

Dairy farmers and workers are exposed to a variety of physical and psychosocial work environment factors that can affect both their physical and mental health (Rautiainen and Reynolds, 2002; Donham and Thelin, 2006; Kolstrup, 2008). A high physical work load, awkward work postures, and repetitive movements, which constitute a risk factor for developing physical health problems such as musculoskeletal disorders (MSD), are also associated with dairy farming (Pinzke et al., 2001; Davis and Kotowski, 2007; Douphrate et al., 2009). A number of national and international studies confirm that MSD is extensively reported by dairy farmers and workers (Holmberg et al., 2002; Kirkhorn and Schenker, 2002; Nonnenmann et al., 2008; Kol-

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strup et al., 2010). Regarding psychosocial work environment factors, some international studies have shown that farmers experience high demands at work and a lack of control of certain external factors such as the weather, the financial situation, or government regulations, and that they report a number of stress-related symptoms and depression (Gregoire, 2002; Fraser et al., 2005; Wallis, 2006). Studies conducted among Swedish farmers show that they experience a high degree of work demands, a high degree of control, as well as some mental health disorders (Lundqvist, 1988a; Thelin et al., 2000; Holmberg et al., 2004). Furthermore, Kolstrup et al. (2008) found that the quality of leadership, feedback, and social support are perceived as insufficient and unsatisfactory by workers employed on Swedish dairy farms.

Dairy farm staff is responsible for the daily welfare and performance of the animals in their care. Lactating dairy cows are frequently handled and well cared for, and the dairy farm staff interacts with the herd at, e.g., feeding, milking, regrouping, treatments, and cleaning. Effective cleaning routines in indoor dairy barns, such as cleaning the milking parlor, manual removal of manure from stalls and walkways, and clearing of feed bunks or mangers, are physically demanding, although necessary in order to maintain good animal health and welfare and milk quality (Ekman, 1998; Barkema et al., 1999; Peeler et al., 2000). According to official Swedish statistics, cows on large dairy farms have a higher incidence of common veterinary-treated clinical cow diseases and mastitis compared with smaller farms, possibly due to increased infection pressure when a large number of animals are kept in the same building (Swedish Board of Agriculture, 2006). Studies have shown that handling, regrouping, and separate milking and treatment of diseased and mastitic cows require extra labor and increase the work load for farm staff (Enting et al., 1997; Sprecher et al., 1997; Rajala-Schultz and Gröhn, 1999).

Until recently, traditional dairy production was characterized by family farming, with herd sizes of less than 50 cows (Statistics Sweden, 2006). Most cows were housed in tied stalls with conventional pipeline milking. However, like most other western countries, Sweden is moving toward fewer and larger dairy farms with increasing numbers of loose-housed cows in free-stall systems with milking parlors, automatic milking systems, or, occasionally, rotary milking systems. This restructuring from small tied herds to large loose-housed herds is likely to influence the work environment and the health of farm staff and cows in many ways. To date, knowledge about work environment exposure and health outcomes in humans working in large dairy systems and about the relationships between dairy farm staff and cow health is limited.

The main aim of this study was to gain a deeper understanding of work-related physical and psychosocial exposure and health symptoms among farm staff working in indoor loose-housing dairy systems in Sweden. A further aim was to study possible associations between the exposure and health symptoms of dairy farm staff and disease incidence in their cows.

Materials and Methods

Selection of Farms

This study formed part of a larger interdisciplinary project in veterinary medicine, animal ethology, animal husbandry, and work science. The objective of the parent project was to study the effects of dairy herd size, housing, and management on ani-

mal health and fertility, and some aspects of the work environment exposure and health symptoms of farm staff. In order to participate in the overall research project, farms had to be located in any of the four major Swedish dairy regions (representing the largest number of dairy cows) and have an indoor loose-housing system with free stalls, a milking parlor, a rotary or automatic milking system, and at least 50 dairy cows per farm. Other requirements were that farm staff worked at least 20 hours per week in the dairy house and that there had been no major rebuilding of the cow house during the preceding 20 months and no plans for immediate major rebuilding.

In Sweden, there is no official register of dairy farms with loose housing. However, the Swedish Dairy Association was able to provide the addresses of 632 farms with free-stall barns, constituting 7% of all Swedish dairy farms with >50 dairy cows in 2003. A first questionnaire regarding farm conditions was distributed to the farmers by mail, and 458 farms responded in December 2003. Based on the collected data, 166 dairy farms met the inclusion criteria and were willing to participate.

At the start of this present study in December 2004, only 113 dairy farms were still participating in the project. A second questionnaire concerning work environment exposure and health outcomes was mailed to these farms. After one reminder, 76 farms replied (67% response rate). Non-respondents were asked to state the reason for choosing not to participate. The main reasons for non-participation were: lack of time (27 farms), sold the farm (two farms), or did not want to participate in the study (eight farms). Data from 15 farms were discarded because the questionnaires were incomplete (eight farms) or because the data on animal health collected from the database were incomplete (seven farms). The study thus comprised useful data from 61 dairy farms with either a farm owner/manager or a directly employed farm worker responding at each farm (54% response rate). The data on farm staff exposure and health outcome were matched to the dairy cow health outcome of the farms. The study design was cross-sectional with retrospective elements.

Questionnaire

The questionnaire was designed to assess perceived work-related physical and psychosocial exposure and health symptoms of farm staff. It was structured into four groups of questions:

Physical exposure, reflecting the respondents' perceived exposure to negative physical factors in their work environment: Have you during the last 12 months regularly experienced discomfort from: noise, vibration, unsuitable climatic conditions, insufficient illumination, lifting heavy burdens, monotonous or repetitive work, awkward working postures, dust, or noxious gases or chemical solvents? The respondents could answer yes or no to each of these nine questions (Lundqvist, 1988a).

Psychosocial exposure, reflecting the respondents' perceived exposure to negative psychosocial factors in their work environment: Do you need to work very fast? Do you have influence over decisions at the workplace? Can you influence the amount of work load assigned to you? Is your work meaningful? Do you feel part of the community at your place of work? Answers were given on a five-level scale (very often or always, rather often, sometimes, rather seldom, and very seldom or never). The five questions were selected from the Copenhagen Psychosocial Questionnaire (Kristensen et al., 2005).

Physical symptoms, reflecting the respondents' perceived work-related musculoskeletal symptoms (MSD) in nine different body parts: Have you during the last 12 months regularly experienced aches, pains, and discomfort in the: neck, shoulders, elbows, hands/wrists, upper back, lower back, hips, knees, or feet? The respondents could answer yes or no to each of these nine questions (Kuorinka et al., 1987).

Psychosocial symptoms, reflecting the respondents' perceived work-related psychosocial symptoms: During the four weeks prior to the study, how often have you experienced: irritation, fatigue, insomnia, headache, nervousness, or abdominal pain? Answers were given on a six-level scale (the whole time, most of the time, a large part of the time, sometimes, a small part of the time, and none of the time). The six questions were selected from the Copenhagen Psychosocial Questionnaire (Kristensen et al., 2005).

Questions concerning individual background factors were also included in the questionnaire, such as gender, age, body weight, height, smoking habits, physical exercise habits, chronic health problems, a history of work-related accidents, number of years spent working with dairy cows, number of hours per week spent working with dairy cows, number of hours per week milking, and herd size.

Database

Cows were mainly of the Swedish Holstein or Swedish Red breeds. For each herd, data on the number of veterinary-reported clinical cases of assisted calving, endometritis, hoof lesions, mastitis, leg injuries, puerperal metritis, retained placenta, and teat lesions during one year, as well as mean milk production per cow, were extracted from an official database, the official Swedish milk and disease-recording schemes (Andersson, 1988; Emanuelson, 1988). The total disease incidence rate was calculated as the total number of cases of the mentioned diseases during 2004 divided by the mean number of cows in the herd in the same year. The mastitis incidence rate was calculated similarly based only on the number of cases of clinical mastitis, which is the most common clinical diagnosis among dairy cows.

Statistical Analysis

The descriptive statistics regarding background factors, perceived physical and psychosocial exposures, and health symptoms were illustrated by number (*n*), frequency (%), mean, median, standard deviation (SD), and interquartile range and are presented by employment type (farm owners/managers and employed farm workers) in tables 1 through 4.

Indices were constructed for each of the four groups of farm staff questions (physical exposure, psychosocial exposure, physical symptoms, and psychosocial symptoms) ranging from 0 (no exposure or symptoms reported by respondents) to 1 (all exposures and symptoms reported by respondents). For each respondent, the indices were calculated as the means of the corresponding scores. For psychosocial exposure and psychosocial symptoms, the original five-level and six-level ordinal scores, respectively, were rescaled linearly to a range of 0 to 1 before calculating the means. Responses indicating psychosocial symptoms that were not work-related (as judged by the respondent) were not included in the calculation of this index. The summary of descriptive statistics of the indices (physical exposure, psychosocial exposure, physical symptoms, and psychosocial symptoms) and the incidence rates of total disease and mastitis were illustrated by median, minimum/maximum, interquartile range, mean, and SD

and are presented by employment type in table 5. The descriptive statistics were created in JMP Statistical Discovery (release 6, SAS Institute, Inc., Cary, N.C.).

Associations between the farm staff indices and cow incidence rates were studied by Spearman rank correlation using the CORR procedure of SAS for Windows (version 9, SAS Institute, Inc., Cary, N.C.) for owners/managers and employed workers separately (table 6). Available background factors were tested as partial variables in the two correlation analyses, but only respondent gender (female or male), age (continuous), BMI (continuous), and number of years in milking (continuous) influenced the estimated associations and were included in the analysis.

Results

Background Factors

Forty-one farm owners/managers and 20 employed farm workers participated in the study, of which 34% and 30%, respectively, were females (table 1). The mean age was 46.5 years for owners/managers and 35.2 years for workers. Thirty-four percent of the owners/managers and 25% of the workers regularly took physical exercise for at least 2 h a week. There were few smokers (2%) and few chronic health problems (7%) among the owners/managers, in contrast to the workers (15% and 21%, respectively). However, the owners/managers had a higher frequency of work-related accidents during the previous 12 months (12%) compared with the workers (10%).

The median time spent working with the cows was 40 h per week in both employment groups, although the owners/manager spent 2 h more per week milking the cows than the workers (table 1). The median number of years working with dairy cows was 23 years among owners/managers and 13.5 years among workers. The owners/managers worked on farms with a median herd size of 72.3 cows and with a median milk production of 8,864 kg per cow per year. The corresponding numbers for farms with workers were 110 cows and 9,237 kg per cow per year. Cows were milked

Table 1. Background factors of 41 farm owners or managers and 20 employed farm workers, and of their cow herds, on 61 Swedish dairy farms in 2004.

Variable	Owners or Managers	Employed Workers
Male ^[a]	27 (66)	14 (70)
Female ^[a]	14 (34)	6 (30)
Age (years) ^[b]	46.5 (11.1)	35.2 (8.70)
Body mass index ^[b]	25.1 (3.20)	25.8 (3.54)
Smoking (yes) ^[a]	1 (2)	3 (15)
Taking physical exercise regularly (at least 2 h per week) (yes) ^[a]	14 (34)	5 (25)
Having chronic health problem (e.g., diabetes, allergy, asthma) (yes) ^[a]	3 (7)	4 (21)
History of work-related accidents during the last 12 months (yes) ^[a]	5 (12)	2 (10)
Time per week spent working with cows (h) ^[c]	40.0 (30.0 - 50.0)	40.0 (30.0 - 40.0)
Time per week spent milking (h) ^[c]	20.0 (10.5 - 24.5)	18.0 (13.4 - 20.0)
Time spent working with dairy cattle (years) ^[c]	23.0 (15.0 - 30.5)	13.5 (4.25 - 20.0)
Herd size ^[c]	72.3 (66.1 - 119)	110 (78.5 - 160)
Milk production per year (kg ECM) ^[c]	8,864 (8,176 - 9,671)	9,237 (8,408 - 9,706)

^[a] Number (percentage).

^[b] Mean (SD).

^[c] Median (interquartile range).

in herringbone, tandem, or parallel milking parlors (54 farms), with an automatic milking system (6 farms), or in a rotary parlor (one farm).

Physical Exposure and Symptoms of Dairy Farm Staff

Perceived work environment factors and work-related physical symptoms were reported frequently in both employment groups (table 2). The most frequently reported physical exposures among owners/managers were monotonous or repetitive work (37% of respondents), unsuitable climate (24%), lifting heavy burdens (17%) and dust (17%). Perceived physical symptoms among owners/managers were especially reported for the lower back (44%), shoulders (44%), neck (27%), and knees (20%). Among the workers, unsuitable climate (40%), lifting heavy burdens (30%), insufficient illumination (25%), monotonous or repetitive work (25%), awkward working postures (20%), and dust (20%) were the most frequently reported physical exposures, and physical symptoms were mostly located in the lower back (47%), shoulders (42%), neck (37%), hands/wrists (32%), upper back (26%), and knees (26%).

Psychosocial Exposure and Symptoms of Dairy Farm Staff

Work-related psychosocial exposure and symptoms among owners/managers and workers are presented in tables 3 and 4. As shown in table 3, 5% of the owners/managers reported that they *always* had to work very fast, while the majority of the owners/managers reported that they had to work very fast *rather often* (28%) or *sometimes* (50%). The owners/managers stated that they *very often* or *rather often* had influence over decisions made on the farm (80% and 18%, respectively) and the amount of work load (54% and 33%, respectively). Ninety-eight percent of the owners/managers reported that farm work *very often* or *rather often* was meaningful and

Table 2. Distribution of reported work-related physical exposure and symptoms during the preceding 12 months among 41 farm owners/managers and 20 workers on 61 Swedish dairy farms in 2004: number (n) and percentage of respondents (%).

Variable	Owners/Managers			Employed Workers		
	Yes		Missing (n)	Yes		Missing (n)
	(n)	(%)		(n)	(%)	
Physical exposure:						
Noise	4	10	0	3	15	0
Vibrations	0	0	0	1	5	0
Unsuitable climatic conditions	10	24	0	8	40	0
Insufficient illumination	4	10	0	5	25	0
Lifting heavy burdens	7	17	0	6	30	0
Monotonous or repetitive work	15	37	0	5	25	0
Awkward working postures	1	2	0	4	20	0
Dust	7	17	0	4	20	0
Noxious gases or chemical solvents	2	5	0	2	10	0
Physical symptoms:						
Neck	11	27	0	7	37	1
Shoulders	18	44	0	8	42	1
Elbows	6	15	0	1	5	1
Hands/wrists	7	17	0	6	32	1
Upper back	3	7	0	5	26	1
Lower back	18	44	0	9	47	1
Hips	2	5	0	2	11	1
Knees	8	20	0	5	26	1
Feet	7	17	0	2	11	1

Table 3. Distribution of reported work-related psychosocial exposure and symptoms among 41 Swedish dairy farm owners/managers in 2004; number (percentage of respondents in parentheses).

	Owners/Managers							
	Very Often or Always	Rather Often	Some-times	Rather Seldom	Very Seldom or Never	No. Missing		
Psychosocial exposure:								
Need to work very fast	2 (5)	11 (28)	20 (50)	4 (10)	3 (8)	1		
Influence over decisions	32 (80)	7 (18)	0	1 (3)	0	1		
Influence over work load	21 (54)	13 (33)	4 (10)	1 (3)	0	2		
Meaning of work	23 (58)	16 (40)	1 (3)	0	0	1		
Sense of coherence	19 (63)	10 (33)	1 (3)	0	0	11		
	Whole Time	Most Time	Large Part of Time	Some-times	Small Part of Time	No Time	Not Work-Related	No. Missing
Psychosocial symptoms:								
Irritation	0	1 (3)	0	4 (10)	24 (60)	8 (20)	3 (8)	1
Fatigue	0	1 (3)	1 (3)	9 (23)	13 (33)	16 (40)	0	1
Insomnia	0	0	1 (2)	2 (5)	5 (12)	33 (80)	0	0
Headache	0	0	0	1 (3)	10 (25)	28 (70)	1 (3)	1
Nervousness	0	0	0	1 (3)	4 (10)	34 (85)	1 (3)	1
Abdominal pain	0	0	0	2 (5)	4 (10)	34 (85)	0	1

Table 4. Distribution of work-related psychosocial exposure and symptoms among 20 Swedish employed dairy farm workers in 2004; number (percentage of respondents in parentheses).

	Employed Workers							
	Very Often or Always	Rather Often	Some-times	Rather Seldom	Very Seldom or Never	No. Missing		
Psychosocial exposure:								
Need to work very fast	2 (10)	4 (20)	11 (55)	2 (10)	1 (5)	0		
Influence over decisions	4 (22)	7 (39)	7 (39)	0	0	2		
Influence over work load	8 (40)	8 (40)	3 (15)	1 (5)	0	0		
Meaning of work	11 (55)	8 (40)	1 (5)	0	0	0		
Sense of coherence	11 (55)	8 (40)	0	0	0	0		
	Whole Time	Most Time	Large Part of Time	Some-times	Small Part of Time	No Time	Not Work-Related	No. Missing
Psychosocial symptoms:								
Irritation	2 (10)	0	3 (15)	3 (15)	6 (30)	1 (5)	5 (25)	0
Fatigue	1 (5)	2 (10)	2 (10)	6 (30)	2 (10)	7 (35)	0	0
Insomnia	1 (5)	1 (5)	3 (15)	1 (5)	1 (5)	12 (60)	1 (5)	0
Headache	2 (10)	0	0	3 (15)	2 (10)	12 (60)	1 (5)	0
Nervousness	0	1 (5)	0	2 (10)	3 (15)	14 (70)	0	0
Abdominal pain	0	0	1 (5)	0	4 (20)	14 (70)	1 (5)	0

96% that they *very often* were part of the community on the farm. Approximately 70% to 85% of the owners/managers did not report experiencing any work-related psychosocial symptoms of insomnia, headache, nervousness, or abdominal pain. However, irritation and fatigue were experienced *a small part of the time* (60% and 33%, respectively) or *sometimes* (10% and 23%, respectively) by the owners/managers.

The majority of the workers reported that they *sometimes* (55%) or *rather often* (20%) had to work very fast, and 10% reported that they *always* had to work very fast (table 4). A large proportion also reported that they *very often* (22%) or *rather often* (39%) had an influence on decisions made on the farm and on the work load assigned to them (40%). Ninety-five percent of the workers stated that their work *very often* or

rather often was meaningful and they felt part of the work community on the farm. Several of the workers (60% to 70%) reported experiencing work-related psychosocial symptoms such as headache, nervousness, or abdominal pain at *no time*. However, 25% of the workers reported work-related symptoms of irritation, fatigue, and insomnia the *whole time, most of the time, and a large part of the time*, respectively. In addition, eight participants reported non-work-related symptoms of irritation, insomnia, headache, or abdominal pain (shown separately in table 4, but not included in the correlation analyses).

Associations between Staff Indices and Cow Disease Incidence Rates

A summary of the indices of perceived work-related physical and psychosocial exposures and symptoms in farm staff and cow disease incidence rates is presented in table 5.

Results from the partial correlations are shown in table 6. In owners/managers, there was a significant negative correlation between the index for physical symptoms and both the total cow disease incidence rate (Spearman $r = -0.35$; $p = 0.032$) and the clinical cow mastitis incidence rate ($r = -0.42$; $p = 0.009$). Thus, owners/managers reported experiencing more physical symptoms in cow herds with lower disease incidence rates. Furthermore, there was a significant positive correlation between the index for psychosocial exposure among workers and both the total cow disease incidence rate and the clinical cow mastitis incidence rate ($r = 0.47$; $p = 0.035$ and $r = 0.47$; $p = 0.036$, respectively), implying that workers experience more exposure to psychosocial factors in cow herds with higher disease incidence rates. In addition, in workers, there was a significant positive correlation between the index for physical exposure and both the index for physical symptoms ($r = 0.63$; $p = 0.003$) and the index for psychosocial symptoms ($r = 0.63$; $p = 0.004$), implying that workers experience more physical and psychosocial symptoms when they perceive themselves as being exposed to negative physical factors (table 6).

Table 5. Summary of indices of physical and psychosocial exposure and symptoms of farm staff and cow disease incidence rates for 61 Swedish dairy farms in 2004.

Staff Indices and Cow Disease Incidence Rates	Median	Min.-Max.	Interquartile Range	Mean	SD
Owners/managers:					
Physical exposure ^[a]	0.11	0 - 0.78	0 - 0.22	--	--
Psychosocial exposure ^[a]	0.19	0 - 0.50	0.13 - 0.25	--	--
Physical symptoms ^[a]	0.11	0 - 0.67	0.11 - 0.33	--	--
Psychosocial symptoms ^[a]	0.07	0 - 0.33	0.03 - 0.17	--	--
Total cow disease incidence rate ^[b]	--	--	--	0.73	0.43
Clinical cow mastitis incidence rate ^[b]	--	--	--	0.16	0.14
Workers:					
Physical exposure ^[a]	0.11	0 - 0.78	0 - 0.42	--	--
Psychosocial exposure ^[a]	0.30	0 - 0.55	0.16 - 0.34	--	--
Physical symptoms ^[a]	0.11	0 - 0.67	0.11 - 0.44	--	--
Psychosocial symptoms ^[a]	0.12	0 - 0.67	0.03 - 0.39	--	--
Total cow disease incidence rate ^[b]	--	--	--	0.53	0.44
Clinical cow mastitis incidence rate ^[b]	--	--	--	0.12	0.14

^[a] Range of the calculated staff index was 0 = no exposures or symptoms reported by the participants to 1 = the participants reported all exposures and symptoms.

^[b] Veterinary-reported clinical cases per cow-year.

Table 6. Spearman partial rank correlations of farm staff exposure and symptoms indices with cow disease incidence rates for 61 Swedish dairy farms in 2004. Respondent gender, age, BMI, and number of years in milking used as partial variables.

First Variable	Second Variable	Owners or Managers			Employed Workers		
		Spearman			Spearman		
		r	p	n	r	p	n
Total cow disease incidence rate	Physical exposure	-0.21	0.191	41	-0.11	0.657	20
	Psychosocial exposure	-0.08	0.605	40	0.47	0.035 ^[a]	20
	Physical symptoms	-0.35	0.032 ^[a]	41	0.15	0.581	19
	Psychosocial symptoms	-0.17	0.310	41	0.01	0.962	19
Clinical cow mastitis incidence rate	Physical exposure	-0.20	0.208	41	0.10	0.676	20
	Psychosocial exposure	-0.06	0.721	40	0.47	0.036 ^[a]	20
	Physical symptoms	-0.42	0.009 ^[b]	41	-0.11	0.692	19
	Psychosocial symptoms	-0.24	0.147	41	0.05	0.856	19
Physical exposure (staff)	Physical symptoms	0.26	0.105	41	0.63	0.004 ^[b]	19
	Psychosocial symptoms	0.19	0.237	41	0.63	0.003 ^[b]	20
	Psychosocial exposure (staff)						
Psychosocial exposure (staff)	Physical symptoms	0.11	0.497	40	0.21	0.399	19
	Psychosocial symptoms	0.25	0.126	40	0.26	0.269	20

^[a] Significance level $p < 0.05$.

^[b] Significance level $p < 0.01$.

Discussion

In this study, two separate groups of dairy farm staff were studied, owners/managers and directly employed workers, with quite different work situations and demographic backgrounds. Compared with workers, the owners/managers were from smaller dairy farms without employees and therefore had to do all the work themselves. They were also older and had longer work experience. These differences meant that the two employment groups were analyzed separately.

Physical Exposure and Symptoms among Dairy Farm Staff

The results indicated that both owners/managers and workers reported high frequencies of perceived physical exposure related to the work environment (such as unsuitable climate, lifting heavy burdens, monotonous and repetitive work, and dust) and work-related physical symptoms in different body parts (mainly the lower back, shoulder, neck, hand/wrists, and knees). High frequencies have also been found in several other studies among Swedish dairy farmers and workers (Stål et al., 1996; Pinzke, 2003; Kolstrup et al., 2006).

In general, owners/managers reported physical exposure and symptoms less frequently than workers. One possible explanation could be under-reporting by the owners/managers or over-reporting by the workers. Even though farmers in general report relatively high frequencies of discomfort from physical factors compared with the general population (24% reported MSD), they seldom take sick leave (Holmberg et al., 2002; Pinzke, 2003; Swedish Work Environment Authority, 2006). Small-scale dairy farming is generally considered to be less technically well-equipped, usually associated with a high work load and, as a consequence, associated with high physical exposure and symptoms (Lundqvist, 1988b; Ahonen et al., 1990; Stål et al., 2000; Pinzke et al., 2001). However, farmers might believe that aches, pains, and discomfort are a

common and accepted hazard that comes with the occupation and therefore under-report exposure and symptoms. In addition, the younger generation of farm workers might not accept physical exposure and symptoms to the same extent as more experienced farmers and might therefore report higher frequencies. The less frequently reported exposures and symptoms among owners/managers could also be explained by the healthy worker effect (Li and Sung, 2004), i.e., that owners/managers experiencing severe ache, pain, or injury had changed occupation or retired early due to illness, while healthy owners/managers stayed in the occupation.

Another explanation for the higher frequency of reported physical exposure and symptoms among workers could be the different sizes of the dairy farms. The workers worked on larger farms (on average 110 cows per herd) with a higher milk yield (9,237 kg milk per cow per year) than the owners/managers. Working on large dairy operations, despite advanced technical equipment, might involve more specialization of work tasks, implying that more time is spent on a limited number of work tasks conducted at a higher tempo (Stål et al., 2003; Kolstrup et al., 2006; Douphrate et al., 2009). This could be associated with an altered and increased work load, resulting in higher frequencies of experienced exposure and symptoms reported by the workers.

Psychosocial Exposure and Symptoms among Dairy Farm Staff

In general, the dairy farm owners/managers reported that they had a high degree of control over their work situation, considered their work meaningful, and had few psychosocial symptoms except for irritation and fatigue. This was in line with previous studies showing that self-employed Swedish farmers experience a high degree of influence and control over their own work situation and find the work stimulating (Lundqvist, 1988a; Thelin et al., 2000; Holmberg et al., 2004). Furthermore, Lundqvist (1988a) found that older Swedish dairy farm owners (≥ 45 years of age) experience fewer conflicts, work fewer hours, and are less anxious than younger owners (30-44 years old).

The results of the present study also indicate that employed workers experience less influence over decisions made on the farm and a higher work pace than owners/managers, which confirms findings in other Scandinavian studies (CASA, 2005; Kolstrup et al., 2008). However, 25% of the workers experienced work-related psychosocial symptoms such as irritation, fatigue, and insomnia. The questions concerning psychosocial exposure and symptoms were few, and they did not provide enough information to explain this result. A possible explanation might be found in the demand-control model proposed by Karasek (1979), which predicts that high demands in combination with a low degree of control at work cause a poor psychosocial work environment and mental health. Studies have shown that many farmers are not very familiar with labor management and probably find being an employer difficult (Bewley et al., 2001; Hadley et al., 2002; Stup et al., 2006). In a study by Kolstrup et al. (2008), employed workers reported that the quality of leadership, feedback, and support were insufficient on dairy farms. Hence, the psychosocial exposure and symptoms reported by farm workers might be related to being employed and having high demands, low control, and inadequate help and support from supervisors.

Associations between Staff Indices and Cow Disease Incidence Rates

The correlation analysis for owners/managers indicated that they experienced significantly more physical symptoms in dairy herds with lower total disease and mastitis incidence rates. Studies have shown that handling and treatment of dairy cows with diseases or mastitis increase the work load, e.g., by grouping and separate milking of the mastitic cows, cleaning and disinfection of milking equipment and stalls, and other hygiene measures to eliminate the cause of infection (Enting et al., 1997; Sprecher et al., 1997; Rajala-Schultz and Gröhn, 1999). Studies conducted by Barkema et al. (1998, 1999) concluded that farmers who worked carefully and accurately with respect to teat cleaning routines, paid more attention to individual cows, and implemented measures to prevent mastitis more often had cows with better udder health and milk quality than farmers with a less accurate management style. Much hard, physical work is thus needed to keep dairy cows free from mastitis and other diseases.

Employed workers reported being more exposed to psychosocial work-related factors in dairy herds with higher disease incidence rates, and reported more physical and psychosocial symptoms when they experienced being exposed to negative physical factors. A possible explanation for these findings could be that the workers felt more stressed or frustrated when the dairy cows had a high incidence of disease and mastitis. The stress or frustration could be an effect of the increased work load due to the extra physical labor involved in cleaning, separating, and treating the mastitic cows or an increased mental work load due to pressure or demands from management to improve herd health. Alternatively, the workers might have had empathy, devotion, and feeling for the cows and experienced these feelings as mentally demanding when the cows were not well. Several studies have demonstrated the importance of good stockmanship and a good human-animal relationship for farm animal health, welfare, and performance (Seabrook, 1984; Hemsworth and Barnett, 1987; Lensink et al., 2000). Despite the fact that dairy farm workers are often required to carry out physically demanding work during irregular working hours, the majority of farm staff in Sweden chose this occupation because they enjoy working with the animals and regard their work as rewarding and meaningful (Kolstrup, 2008). A Swedish study showed that dairy farm workers gained the greatest pleasure from their work in promoting the welfare of the animals and from the milking (Pinzke, 2003). Furthermore, a study by Kolstrup (2010) revealed that good animal health and welfare are important for motivation and job satisfaction among dairy farm workers. However, the workers' empathy for the animals might also make them more susceptible to perceiving their own aches, pains, and discomfort. The significant correlation between cow diseases and indices among workers could also be related to labor management issues, as discussed in the previous sections on perceived physical and psychosocial exposure and symptoms among farm staff.

The implication of our study is that dairy farming in loose-housing systems can be physically and psychosocially demanding and might put the health of owners/managers and workers at risk, but that they enjoy working with their cows. An improved working environment with a lower physical and psychosocial work load would be beneficial for both humans and animals. It is important to continue to integrate the needs of the farm staff and the animals in the design of livestock barns, and in choosing and developing a management style that best serves the demands of the

humans and the animals. Further technical aid as well as education is needed in order to make the work places and work situations for dairy farm staff more attractive, safe, and healthy.

Methodology

The present study adopted an interdisciplinary and holistic approach, incorporating important aspects of work environment exposure in dairy farming, and human and animal health outcomes. However, the study design was cross-sectional with retrospective elements, which reduces the possibilities to reveal causality.

In almost all Swedish mail surveys, the response rate has decreased during recent years. A low response rate also limited the representativeness of this study. The results are therefore only indicative of associations, not of causal relationships. Nevertheless, several results reflected findings by earlier studies with a larger number of participants.

To achieve an acceptable response rate, we chose not to use the original extended questionnaires on physical and psychosocial exposures and symptoms. The questionnaire used therefore comprised a relatively limited number of physical and psychosocial factors and symptoms, thus representing a narrow definition of the staff health concept. In future studies, it would be preferable to enlarge the number of variables describing human health in order to get more accurate characterization. Having symptoms that a respondent believes might be related to a variety of exposures in the work environment renders the individual more prone to remember and report such exposures and symptoms, and more inclined to participate in this kind of study (Coggan et al., 1993; Last, 2001). In addition, the use of questionnaires can influence the respondents' own perceptions of their work environment and health. Thus, this subjective perception should be considered to obtain a correct picture of how the work influences the respondent's health (Rubenowitz, 1984).

Animal health was represented here by the herd incidence rate of veterinary-treated cases of mastitis and of eight common clinically diagnosed diseases. Although the latter is likely to reflect the overall animal health status in the herds, it does not include other important aspects of animal well-being and health. Not all animal diseases are reported by veterinarians to the official animal disease recording scheme. In particular, hoof lesions are to a great extent diagnosed and treated by non-veterinarians in Sweden (Hultgren et al., 2004). The calculated disease incidence rates were comparable to those of other Swedish herds, e.g., the Swedish Dairy Association (2005) reported 16.2 cases of mastitis per 100 animals in 2004.

Conclusions

It was confirmed that exposures to physical and psychosocial work environment factors and related symptoms are not uncommon among both owners/managers and employed workers on Swedish dairy farms with loose-housed cows. This study found that farm owners/managers experienced more physical symptoms in dairy herds with lower cow disease incidence rates, and that a high herd incidence rate was associated with more frequent or intensive exposures to negative psychosocial work environment factors among directly employed dairy workers.

The results from the present study raise questions for further research. The next step would be to further investigate the direction of the associations found between farm staff and animal health. Such a study should incorporate a greater number of participants and gather more detailed data on human and animal health and welfare, dairy house design, the extent and condition of the dairy house and technical equipment, work organization, labor management style, working routines, and workers' attitudes to the animals in their care.

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