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LOW BACK PAIN COMORBIDITY AMONG MALE FARMERS AND RURAL REFERENTS: A POPULATION-BASED STUDY

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Abstract: Farmers report more low back pain (LBP) than rural referents. We have previously demonstrated that the difference in reporting rate cannot be fully explained by known risk factors such as physical work exposures, psychosocial factors and lifestyle. Other etiological factors must be involved. In this cross-sectional population-based study, we investigate LBP comorbidity in terms of coexistent symptoms. A total of 1,013 male farmers, 40-60 years old, and 769 matched rural referents participated in an extensive health survey. Information on causes of primary health care and hospital admissions, symptoms, lifestyle factors, physical work exposures and psychosocial factors were gathered through standardized interviews and questionnaires. In the combined farmer-referent group, the prevalence of LBP was associated with musculoskeletal symptoms other than LBP, chest discomfort, dyspepsia, symptoms from eyes, nose and throat mucous membranes, skin problems, work-related fever attacks, and primary care appointments due to digestive disorders. The associations were independent of age, educational level, smoking habits, body mass index, physical work exposures and psychosocial factors. Presence of both respiratory and digestive disorders doubled the LBP prevalence. Significant associations between LBP and digestive and respiratory disorders were revealed, indicating that LBP and these disease entities may have etiological factors in common.

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INTRODUCTION

Low back pain (LBP) is a common complaint among the general population with a subgroup developing chronic and disabling symptoms generating large societal costs. Although much research effort has been spent and several risk factors such as heavy lifting, lifestyle and psychosocial factors identified [5, 6, 8, 22], the etiology of LBP is still unclear. New approaches are needed and one proposal is to consider comorbidity [18]. The rationale for such studies is that if 2 or more diseases occur simultaneously, they may have a common origin. Comorbidity studies might then produce new ideas on disease etiology.

Comorbidity associated with LBP has been sparsely studied but is often noticed in studies concerning disability or pensions. However, there are some reports indicating positive cross-sectional associations between LBP on the one hand, and headache [15, 43], cardiovascular symptoms [15, 38] and cardiovascular risk factors [4] on the other, but no association with cardiovascular deaths [16, 31]. A few studies have shown

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a significant association between LBP and respiratory disorders [15, 17, 42, 43], poor self-perceived general health [23, 43] and anxiety and depression [37]. Patients with functional gastrointestinal disorders, such as irritable bowel syndrome, frequently report other somatic complaint such as LBP [3] and other pain syndromes [10].

In a previous cross-sectional study, we demonstrated that Swedish middle-aged farmers have an increased risk of LBP compared to matched rural referents [19]. The farmer-referent cohort is therefore a possible model for studying LBP etiology. We have subsequently shown that physical work exposure, lifestyle and psychosocial factors do not fully account for the increased rate of LBP among farmers [20, 21]. The occupational exposure in farming is quite different from other physically demanding occupations, for example, through animal contacts, dust and mould exposure and exposure to infectious agents [2, 32]. Besides musculoskeletal disorders [39] and injuries, respiratory disorders seem to be occupationally related to agriculture [35]. If exposure to immunologically active substances has an impact on the risk of musculoskeletal symptoms and disorders, associations between, for example, respiratory and digestive disorders and LBP might be expected.

We therefore decided to investigate possible associations between LBP prevalence on the one hand and the prevalence of other symptoms, causes of primary care appointments and causes of hospital admissions on the other in a cross-sectional survey.

STUDY POPULATION AND METHODS

All male farmers born between 1930–1949 and living in 9 rural Swedish municipalities across the country were identified in 1989 using the national farm register. Farmers were defined as persons who owned or rented a farm and spent at least 25 hours per week in farming. Farm laborers were thus not included. To ensure the occupational affiliation to farming, the local representatives in the local branches of the Federation of Swedish Farmers were consulted. Overall, 1,221 farmers fulfilled the sampling criteria.

A reference population was sampled from the national population register. The referents were matched to the farmers by age, sex and residential area and had to be occupationally active. An age mismatch of ±3 years was allowed. Since most Swedish municipalities consist of rural areas as well as urban dwellings, the smallest official administrative area (parish) was used to define residential area in order to ensure that the farmers and referents were living in the same local area. After this procedure, 1,130 referents were sampled. Because the areas were rural, the number of potential reference subject was limited and therefore the included referents were somewhat fewer than the farmers.

The 1,221 farmers and 1,130 referents were invited to a baseline survey conducted by 2 co-trained teams of physicians and technicians during a 12-month period to allow for possible seasonal variation. 1,013 (83%) farmers and 769 (68%) referents participated. A detailed description of the sampling procedure, the survey and an analysis of the reasons for and effects of non-participation have been given elsewhere [19, 36].

All data concerning symptoms were assessed in self-administered questionnaires answered on location during the survey. Occurrence of LBP during the past year (problems in the low back area with ache, pain or discomfort) was assessed as “yes” or “no”. Lifetime experience of musculoskeletal symptoms (neck and shoulders, hands and forearms, low back, hips and knees) was similarly assessed. Effort-related chest discomfort, dyspepsia and symptoms from mucous membranes (eyes, nose, mouth and throat) during the past year were enquired about. Allergic manifestations during lifetime (asthma, hay fever, atopic eczema and work-related fever attacks) were assessed, and standard questions for bronchitis were used.

Self-reported information on causes of appointments at primary health care centres and hospital admissions was collected by standardized interviews performed by a physician. The diagnostic information was coded according to the International Classification of Diseases (ICD-9) [1].

The variables, age, socio-economic status, smoking habits, body mass index (BMI), workload and psychosocial factors were included in the analyses as potential confounders. Educational level was chosen to indicate socio-economic status and was classified as mandatory school only, vocational school, secondary school, college or university education. Smoking habits were assessed in the structured interview as never smoked, current daily smoking, and ex-smoker. For this report, smoking habits was dichotomized on current daily smoking versus no smoking. Weight was measured on a lever balance to the nearest tenth of a kilogram with the participant dressed in light sportswear. Height was measured without shoes to the nearest centimeter with a transportable scale fixed to the lever balance. BMI was calculated as weight divided by height squared (kg/m^2).

Physical workload was assessed as the reported average number of hours working in a sitting or standing position, with a moderate, heavy or very heavy workload during an average working day according to Edholm’s activity scale [26]. Frequent exposure to work in difficult working positions was recorded as “yes” or “no”. Psychological work demands were assessed according to Karasek and Theorell [27]. The number of persons in the household unit (household size) included the participant.

Statistical analysis. The statistical analyses were performed with SPSS, SAS and JMP software. The partial non-response rate (missing data from responders) was generally less than 2%, for most variables much lower, and therefore not shown in Tables. For causes of primary care or hospital admissions, all participants contributed data.

Associations between background characteristics and farmer-referent status were analyzed with the Chi^2-test and Students *t*-test. Ordinal logistic regression models were used to compute adjusted odds ratios (OR) and their 95% confidence intervals (95% CI) for the various symptoms and causes of care with LBP as the dependent variable. The LBP outcome variable was graded into never LBP (=0), previous LBP (=1) and LBP during the past year (=2). Adjustments were made for potential confounding variables (educational level, smoking habits, BMI, work exposure and psychosocial factors).

Analyses where farmers and referents were contrasted were performed conditional and unconditional, i.e. keeping the matched pairs together or disregarding matching. The results of the 2 approaches were similar. However, since this report is focussed on comorbidity, regardless of occupational group, the results of the unconditional analyses are presented.

A respiratory disease score was computed as the sum of the codes for chest discomfort (0 or 1), symptoms from mucous membranes in the eyes, nose and throat area (0 or 1) and work-related fever attacks (0 or 1), total score range 0–3. A digestive disease score was computed as the sum of the codes for dyspepsia (0 or 1) and primary health care for digestive disorders (0 or 1), total score range 0–2.

To estimate the degree to which the two scores could “explain” the variation of LBP reporting the correlation coefficient squared (r^2), the standard measure, was used. However, it is heavily influenced by random variation when addressing categorical outcomes. For this reason, the area under the curve of a receiver operator characteristic (ROC) diagram, with sensitivity rate on the vertical axis and inverted specificity rate on the horizontal axis, was used as an additional measure. Random variation and other bias influence this measure far less. The “degree of explanation” (ROC %) was calculated as (area fractile - 0.5) × 2 × 100.

All tests were two-tailed. A p-value of <0.05 was regarded as indicating statistical significance. Very small p-values are denoted <0.0001, even if they were much smaller.

RESULTS

Mean age was 50.3 years, with no significant difference between farmers and referents. Fewer farmers than referents had only mandatory schooling and fewer farmers had college or university education (Tab. 1). Smoking was significantly more prevalent among the referents. No significant difference in BMI was found between farmers and referents, but physical work exposure and psychosocial factors differed significantly.

Almost two thirds (64%) of the study population had experienced LBP at some time during their lifetime. More farmers than referents reported LBP both during lifetime and during the past year (p < 0.0001) (Tab. 2), and also more of other musculoskeletal symptoms, whereas fewer farmers than referents reported chest discomfort and dyspepsia. Twelve percent of the farmers (121 individuals) and 1.7 percent of the referents (13 individuals) reported work-related fever attacks (p<0.0001). Psychiatric causes of primary care and hospital admission were less prevalent among farmers, and minor traumatic injuries handled in primary care more frequent.

Reporting of musculoskeletal symptoms other than LBP (neck, hands, hips and knees) was associated with LBP prevalence (Tab. 3). The associations were similar for farmers and referents. In the combined farmer-referent group, LBP was also associated with chest discomfort, dyspepsia, symptoms from mucous membranes, skin problems, work-related fever attacks, and primary health care for digestive disorders. In addition, LBP was associated with primary care for ear-related disorders among referents, but not among farmers or in the combined study group.

Table 1. Characteristics of the study population.

	Farmers (N = 1,013)				Referents (N = 769)				
	n	%	mean	SD	n	%	mean	SD	p
Education									<0.0001
Mandatory school	393	39.8			329	43.9			
Vocational school	384	38.9			167	22.3			
Secondary school	120	12.1			65	8.7			
College	39	3.9			84	11.2			
University	52	5.3			104	13.9			
Smoking habits									<0.0001
Never smoker	559	55.2			280	36.5			
Ex-smoker	276	27.3			251	32.7			
<10 cigarettes/day	77	7.6			65	8.5			
>10 cigarettes/day	100	9.9			172	22.4			
Body mass index, kg/m^2	1,013		26.3	3.2	769	26.6	3.2		0.071
Physical workload, units	1,003		236.7	69.4	743		142.2	71.9	<0.0001
Difficult working positions	744	75.0			305	41.0			<0.0001
Demands in work	929		13.2	2.4	695		12.0	2.8	<0.0001
Household size	998		3.2	1.3	756		2.8	1.2	<0.0001

Table 2. Frequency distribution of symptoms, causes of primary care and hospital admissions for farmers and referents.

	Farmers		Referents		
	n	%	n	%	p
Never LBP	317	31.2	315	41.5	<0.0001
Previous LBP	213	21.2	151	19.9	
LBP past year	473	47.1	293	38.6	
Other musculoskeletal symptoms					
Neck-shoulder pain, ever	574	56.8	408	53.2	n.s.
Hand-forearm pain, ever	361	35.7	223	29.2	0.004
Hip pain, ever	318	31.7	160	21.0	<0.0001
Knee pain, ever	471	46.7	338	44.2	n.s.
Other symptoms					
Chest discomfort, past year	117	11.6	126	16.6	0.003
Dyspepsia, past year	293	29.2	262	34.4	0.018
Mucous membrane, past year	268	26.7	196	25.8	n.s.
Asthma, ever	52	5.1	41	5.4	n.s.
Hay fever, ever	84	8.3	64	8.4	n.s.
Atopic eczema, ever	25	2.5	23	3.0	n.s.
Bronchitis, probable	39	3.9	23	3.0	n.s.
Skin problems, ever	159	15.8	138	18.1	n.s.
Work-related fever attacks, ever	121	12.0	13	1.7	<0.0001
Primary care					
Infectious diseases	19	1.9	18	2.3	n.s.
Endocrine disorders	26	2.6	25	3.3	n.s.
Psychiatric disorders	35	3.5	42	5.5	0.039
Eye-related disorders	45	4.4	54	7.0	0.019
Ear-related disorders	72	7.1	74	9.6	n.s.
Circulatory disorders	115	11.4	99	12.9	n.s.
Respiratory disorders	80	7.9	69	9.0	n.s.
Digestive disorders	144	14.2	143	18.6	0.013
Urinary tract disorders	57	5.6	55	7.2	n.s.
Skin disorders	23	2.3	32	4.2	0.022
Miscellaneous	31	3.1	23	3.0	n.s.
Injuries and intoxication	374	36.9	202	26.3	<0.0001
Hospital admissions					
Infectious diseases	25	2.5	22	2.9	n.s.
Endocrine disorders	11	1.1	11	1.4	n.s.
Psychiatric disorders	4	0.4	15	2.0	0.002
Eye-related disorders	21	2.1	12	1.6	n.s.
Ear-related disorders	24	2.4	23	3.0	n.s.
Circulatory disorders	55	5.4	47	6.1	n.s.
Respiratory disorders	43	4.2	42	5.5	n.s.
Digestive disorders	148	14.6	134	17.4	n.s.
Urinary tract disorders	36	3.6	47	6.1	0.011
Skin disorders	3	0.3	6	0.8	n.s.
Miscellaneous	28	2.8	22	2.9	n.s.
Injuries and intoxication	181	17.9	143	18.6	n.s.

In Figure 1, LBP prevalence rates are shown by various combinations of respiratory disease and digestive disease score. For LBP during the past year the prevalence rate ranged from 35% for subjects with respiratory disease and digestive disease score 0 to 79% for those with digestive disease score 2 and respiratory disease score 3. The corresponding prevalence rates for LBP during lifetime were 55% and 92%. The association between LBP and number of work-related fever attacks ($p<0.05$), shown in Table 4, was graded indicating a dose-response-relationship.

The degree to which variation in the respiratory disease and digestive disease scores could explain variation in the prevalence of LBP during the past year and LBP ever is shown in Table 5. With the r^2 measure, the degree of explanation was moderate, 2.8% or less. In the ROC analyses the explanatory effects were larger, 11–21%. Using the two scores and all adjustment variables gave 5–

Table 3. Associations between low back pain and other symptoms, causes of primary care and hospital admissions for farmers and referents. Odds ratios (OR) with 95% confidence intervals (95% CI) computed with ordinal logistic regression with adjustment for the influence of educational level, smoking habits, body mass index, physical workload, difficult working positions, work demands and household size. Significant associations are in bold type.

	Farmers		Referents		Total	
	OR	95%CI	OR	95%CI	OR	95%CI
Symptoms						
Neck-shoulder pain	**1.99**	**1.54- 2.57**	**2.09**	**1.55- 2.83**	**2.04**	**1.68- 2.48**
Hand-forearm pain	**1.80**	**1.37- 2.36**	**1.74**	**1.24- 2.44**	**1.78**	**1.44- 2.20**
Hip pain	**2.23**	**1.68- 2.96**	**3.19**	**2.13- 4.76**	**2.53**	**2.01- 3.18**
Knee pain	**1.81**	**1.40- 2.34**	**1.78**	**1.32- 2.41**	**1.77**	**1.46- 2.15**
Chest discomfort	**2.04**	**1.32- 3.14**	1.50	0.98- 2.29	**1.69**	**1.29- 2.28**
Dyspepsia	**1.50**	**1.13- 1.99**	**2.28**	**1.66- 3.13**	**1.76**	**1.43- 2.17**
Mucous membrane	**1.80**	**1.34- 2.42**	**1.54**	**1.09- 2.18**	**1.67**	**1.33- 2.08**
Asthma	0.70	0.38- 1.27	1.13	0.56- 2.27	0.85	0.54- 1.33
Hay fever	0.93	0.59- 1.46	1.24	0.72- 2.15	1.02	0.72- 1.44
Atopic eczema	1.27	0.56- 2.91	1.62	0.70- 3.72	1.42	0.79- 2.54
Bronchitis	1.25	0.64- 2.43	1.24	0.50- 3.04	1.25	0.73- 2.13
Skin problems	**1.45**	**1.02- 2.06**	1.44	0.98- 2.12	**1.44**	**1.11- 1.87**
Work-related fever attacks	**1.75**	**1.16- 2.66**	2.71	0.71- 10.3	**1.96**	**1.32- 2.90**
Primary care						
Infectious diseases	0.76	0.29- 1.97	1.01	0.40- 2.55	0.93	0.48- 1.80
Endocrine disorders	1.23	0.55- 2.76	0.66	0.28- 1.57	0.93	0.53- 1.66
Psychiatric disorders	1.64	0.80- 3.37	0.94	0.49- 1.81	1.20	0.75- 1.92
Eye-related disorders	1.63	0.88- 3.04	1.02	0.55- 1.88	1.31	0.85- 2.02
Ear-related disorders	0.74	0.45- 1.20	**1.69**	**1.00- 2.86**	1.10	0.77- 1.56
Circulatory disorders	0.70	0.48- 1.04	1.01	0.64- 1.59	0.81	0.60- 1.09
Respiratory disorders	1.35	0.82- 2.22	0.85	0.50- 1.45	1.06	0.74- 1.51
Digestive disorders	**1.64**	**1.13- 2.38**	**1.65**	**1.12- 2.45**	**1.63**	**1.25- 2.13**
Urinary tract disorders	0.75	0.44- 1.29	1.26	0.72- 2.22	0.94	0.64- 1.38
Skin disorders	0.64	0.27- 1.54	1.35	0.66- 2.76	0.99	0.57- 1.71
Injuries and intoxication	1.18	0.91- 1.53	1.16	0.83- 1.62	1.20	0.98- 1.48
Miscellaneous	1.14	0.59- 2.21	**2.31**	**1.13- 4.70**	1.59	0.98- 2.57
Hospital admissions						
Infectious diseases	0.82	0.37- 1.83	0.91	0.37- 2.22	0.90	0.50- 1.64
Endocrine disorders	0.31	0.08- 1.16	1.04	0.32- 3.40	0.58	0.24- 1.40
Psychiatric disorders	1.10	0.18- 7.19	1.18	0.39- 3.53	1.13	0.44- 2.87
Eye-related disorders	1.32	0.52- 3.35	0.84	0.25- 2.78	1.09	0.53- 2.25
Ear-related disorders	1.22	0.53- 2.81	1.82	0.77- 4.30	1.42	0.78- 2.58
Circulatory disorders	0.94	0.52- 1.70	0.89	0.47- 1.68	0.93	0.61- 1.43
Respiratory disorders	1.77	0.89- 3.50	1.33	0.72- 2.49	1.43	0.91- 2.24
Digestive disorders	0.93	0.65- 1.33	0.96	0.64- 1.43	0.94	0.72- 1.22
Urinary tract disorders	0.83	0.43- 1.62	1.31	0.71- 2.39	1.04	0.67- 1.63
Skin disorders	1.77	0.18- 16.9	4.39	0.53- 36.5	2.87	0.62- 13.2
Injuries and intoxication	0.93	0.69- 1.27	1.19	0.82- 1.73	1.05	0.83- 1.32
Miscellaneous	1.14	0.52- 2.49	1.47	0.53- 4.08	1.30	0.70- 2.42

6% degree of explanation with the r^2 method and 32% with the ROC method.

DISCUSSION

LBP was thus associated with respiratory disease symptoms and with digestive disorders among rural middle-aged men. There was a graded and significant association between work-related fever attacks, reported by approximately 10% of the farmers, and LBP.

The participants were rural men from various parts of Sweden. The farmers' occupational affiliation to farming and the referents' to other occupations was assured. The farmers included in the study are representative of the Swedish farming population with regard to geographical distribution and productivity [19]. We regard the participation rate of 76% as satisfactory considering the extent of the survey and that the study population was population based.

All information was collected on pre-prepared forms and validated questionnaires and measurement methods were used. The use of self-reported data on musculoskeletal disorders has been found to be reasonably accurate for epidemiological use [14]. In a previous study, we showed that interview data on hospital admissions corresponded well with register data on

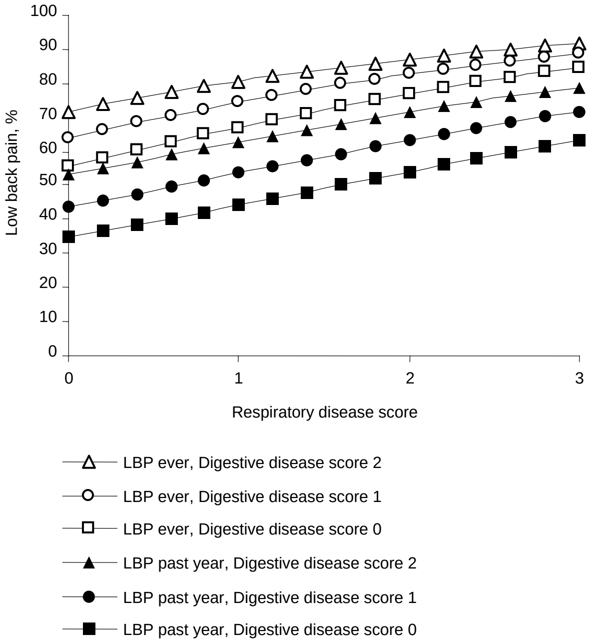

Figure 1. Prevalence rates of low back pain ever during life and during the past year by respiratory disease score and digestive disease score.

Table 4. Associations between low back pain during the past year and work-related fever attacks adjusted for farmer-referent status, educational level, smoking habits and body mass index in the total study population. OR = odds ratio, 95%CI = 95% confidence interval.

Low Back Pain	n	OR	95% CI
Number of work-related fever attacks			
No attacks	1583	1.00	
1-2 attacks	54	1.36	0.78-2.36
3 or more attacks	63	2.15	1.27-3.65

Table 5. Degree to which variation in independent variables explain variation in the prevalence of low back pain (LBP). r^2=correlation coefficient squared, ROC%=proportion (%) of receiver operating characteristic diagram area under the sensitivity-specificity curve.

	Degree of explanation			
	LBP past year		LBP ever	
Independent variables	r^2	ROC%	r^2	ROC%
Respiratory disease score alone, %	1.6	13.7	2.0	16.2
Digestive disease score alone, %	1.1	11.3	1.0	11.0
Respiratory and digestive disease score, %	2.4	19.2	2.8	21.4
Respiratory and digestive disease score + education + smoking + body mass index + physical work exposure + psychosocial factors, %	5.3	31.5	5.8	32.3

hospital admissions (national hospital admissions register) for the study population [36]. Others also found good concordance between reported and registered health care utilization [33]. The variables indicative of physical work exposure and psychosocial factors, included in the final models, were significantly related to LBP in previous analyses, based on the same study population [20, 21]. We have no reason to believe that the potential bias might influence the results to such an extent that the conclusions would be affected.

A recently published literature review based on 23 articles indicated positive associations between LBP and several disorders, such as headache/migraine, respiratory disorders, cardiovascular disease, general health and others [18]. However, there is no evidence on a common causal mechanism and several explanations could be at hand. First, LBP might itself cause other diseases, through somato-visceral reflexes or other influences on the central nervous system [7]. Secondly, other diseases or health problems might, through psychological or viscero-somatic reflexes, cause LBP [13]. Thirdly, certain clusters of individuals might be more prone to report symptoms or more eager to seek medical care, or there might be other biologic or psychosocial relationships. Finally, LBP and its comorbidity may have a common origin.

Hurwitz and Morgenstern [25] hypothesized that an inflammatory effect from preceding stressors might activate the hypothalamic-pituitary-adrenal (HPA) axis, resulting in depression and pain as independent outcomes. They further hypothesized allergic reactions as markers for inflammation-associated activation of the HPA axis. In a cross-sectional study using data from the third NHANES, they showed significant associations between LBP, allergy and major depression [24].

Farmers are frequently exposed to potentially immunologically active substances. Exposure to organic dust in farming has been associated with respiratory disorders [28, 34], airway symptoms [12] and febrile reactions [29]. Work-related fever attacks, caused by exposure to mould, unspecific dust or endotoxins are much more common among farmers than among non-farmers [9]. We found no studies on the relationship between this type of work-related fever attacks and musculoskeletal disorders. The association found in our study might support the hypothesis of immunological mechanisms being involved in the development of musculoskeletal disorders. A recent case-control study reported that farmers and farm workers have an increased risk of rheumatoid arthritis and systemic inflammatory reactions due to organic dust inhalation [30].

The high prevalence rate of musculoskeletal disorders among farmers has so far been attributed to ergonomics and injuries [41]. A recent case-referent study on farmers diagnosed with hip osteoarthritis and matched farmers free of this disease, demonstrated that work in animal production (dairy or swine confinement) was significantly related to hip osteoarthritis, also after adjustment for physical workload factors [40].

Most studies on relationships between LBP and gastrointestinal symptoms or digestive disorders focus on medication side effects, especially from non-steroid anti-inflammatory drugs. Some studies, however, indicate positive relationships between LBP and digestive disorders. For example, patients with irritable bowel syndrome frequently report other somatic complaint such as LBP [3]. In Canada, persons with digestive disorders were more likely to be disabled by neck pain than were individuals without digestive disorders [11]. In our study, dyspepsia during the past year and primary care due to digestive disorders was positively associated with LBP also after physical work exposures and psychosocial factors were included in the model. An association between LBP and digestive disorders might be logical if immunological mechanisms have an impact on the risk of low back pain.

CONCLUSION

Significant associations between LBP and digestive and respiratory disorders were revealed. The presence of these 2 factors doubled the LBP prevalence. A significant and graded relationship between work-related fever attacks and LBP was found, indicating that LBP and these disease entities may have etiological factors in common.

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REFERENCES

1. *International Classification of Diseases, Ninth Revision* (ICD-9), Swedish version. Allmänna förlaget, Stockholm, Sweden 1986.

2. Ahlm C, Thelin A, Elgh F, Juto P, Stiernström EL, Holmberg S, Tärnvik A: Prevalence of antibodies specific to Puumala virus among farmers in Sweden. *Scand J Work Environ Health* 1998, **24**, 104-108.

3. Azpiroz F, Dapoigny M, Pace F, Muller-Lissner S, Coremans G, Whorwell P, Stockbrugger RW, Smout A: Nongastrointestinal disorders in the irritable bowel syndrome. *Digestion* 2000, **62**, 66-72.

4. Battie MC, Bigos SJ, Fisher LD, Hansson TH, Nachemson AL, Spengler DM, Wortley MD, Zeh J: A prospective study of the role of cardiovascular risk factors and fitness in industrial back pain complaints. *Spine* 1989, **14**, 141-147.

5. Bigos SJ, Battie MC, Spengler DM, Fisher LD, Fordyce WE, Hansson TH, Nachemson AL, Wortley MD: A prospective study of work perceptions and psychosocial factors affecting the report of back injury. *Spine* 1991, **16**, 1-6.

6. Bongers PM, de Winter CR, Kompier MA, Hildebrandt VH: Psychosocial factors at work and musculoskeletal disease. *Scand J Work Environ Health* 1993, **19**, 297-312.

7. Budgell BS: Reflex effects of subluxation: the autonomic nervous system. *J Manipulative Physiol Ther* 2000, **23**, 104-106.

8. Burdorf A, Sorock G: Positive and negative evidence of risk factors for back disorders. *Scand J Work Environ Health* 1997, **23**, 243-256.

9. Carvalheiro MF, Peterson Y, Rubenowitz E, Rylander R: Bronchial reactivity and work-related symptoms in farmers. *Am J Ind Med* 1995, **27**, 65-74.

10. Chang L: The association of functional gastrointestinal disorders and fibromyalgia. *Eur J Surg Suppl* 1998, **(583)**, 32-36.

11. Cote P, Cassidy JD, Carroll L: The factors associated with neck pain and its related disability in the Saskatchewan population. *Spine* 2000, **25**, 1109-1117.

12. Donham K, Haglind P, Peterson Y, Rylander R, Belin L: Environmental and health studies of farm workers in Swedish swine confinement buildings. *Br J Ind Med* 1989, **46**, 31-37.

13. Drewes AM, Petersen P, Qvist P, Nielsen J, Arendt-Nielsen L: An experimental pain model based on electric stimulations of the colon mucosa. *Scand J Gastroenterol* 1999, **34**, 765-771.

14. Fredriksson K, Toomingas A, Torgen M, Thorbjörnsson CB, Kilbom A: Validity and reliability of self-reported retrospectively collected data on sick leave related to musculoskeletal diseases. *Scand J Work Environ Health* 1998, **24**, 425-431.

15. Gyntelberg F: One year incidence of low back pain among male residents of Copenhagen aged 40-59. *Dan Med Bull* 1974, **21**, 30-36.

16. Heliövaara M, Mäkelä M, Aromaa A, Impivaara O, Knekt P, Reunanen A: Low back pain and subsequent cardiovascular mortality. *Spine* 1995, **20**, 2109-2111.

17. Heliövaara M, Mäkelä M, Knekt P, Impivaara O, Aromaa A: Determinants of sciatica and low-back pain. *Spine* 1991, **16**, 608-614.

18. Hestbaek L, Leboeuf-Yde C, Manniche C: Is low back pain part of a general health pattern or is it a separate and distinctive entity? A critical literature review of comorbidity with low back pain. *J Manipulative Physiol Ther* 2003, **26**, 243-252.

19. Holmberg S, Stiernström EL, Thelin A, Svärdsudd K: Musculoskeletal symptoms among farmers and non-farmers: a population-based study. *Int J Occup Environ Health* 2002, **8**, 339-345.

20. Holmberg S, Thelin A, Stiernström E, Svärdsudd K: Psychosocial factors and low back pain, consultations and sick leave among farmers and rural referents: a population-based study. *J Occup Environ Med* 2004, **46(9)**, 993-998.

21. Holmberg S, Thelin A, Stiernström EL, Svärdsudd K: The impact of physical work exposure on musculoskeletal symptoms among farmers and rural non-farmers. A population-based study. *Ann Agric Environ Med* 2003, **10**, 179-184.

22. Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM: Physical load during work and leisure time as risk factors for back pain. *Scand J Work Environ Health* 1999, **25**, 387-403.

23. Hurwitz EL, Morgenstern H: Correlates of back problems and back-related disability in the United States. *J Clin Epidemiol* 1997, **50**, 669-681.

24. Hurwitz EL, Morgenstern H: Cross-sectional associations of asthma, hay fever, and other allergies with major depression and low-back pain among adults aged 20-39 years in the United States. *Am J Epidemiol* 1999, **150**, 1107-1116.

25. Hurwitz EL, Morgenstern H: Immediate and longterm effects of immune stimulation: hypothesis linking the immune response to subsequent physical and psychological wellbeing. *Med Hypotheses* 2001, **56**, 620-624.

26. Ilmarinen J, Knauth P, Klimmer F, Rutenfranz J: The applicability of the Edholm Scale for activity studies in industry. *Ergonomics* 1979, **22**, 369-379.

27. Karasek R, Theorell T: *Healthy work. Stress, productivity, and the reconstruction of working life*. Basic Books, New York 1990.

28. Malmberg P: Health effects of organic dust exposure in dairy farmers. *Am J Ind Med* 1990, **17**, 7-15.

29. Malmberg P, Rask-Andersen A, Rosenhall L: Exposure to microorganisms associated with allergic alveolitis and febrile reactions to mold dust in farmers. *Chest* 1993, **103**, 1202-1209.

30. Olsson AR, Skogh T, Axelson O, Wingren G: Occupations and exposures in the work environment as determinants for rheumatoid arthritis. *Occup Environ Med* 2004, **61**, 233-238.

31. Penttinen J: Back pain and risk of fatal ischaemic heart disease: 13 year follow up of Finnish farmers. *BMJ* 1994, **309**, 1267-1268.

32. Radon K, Danuser B, Iversen M, Monso E, Weber C, Hartung J, Donham K, Palmgren U, Nowak D: Air contaminants in different European farming environments. *Ann Agric Environ Med* 2002, **9**, 41-48.

33. Reijneveld SA, Stronks K: The validity of self-reported use of health care across socioeconomic strata: a comparison of survey and registration data. *Int J Epidemiol* 2001, **30**, 1407-1414.

34. Rylander R: Lung diseases caused by organic dusts in the farm environment. *Am J Ind Med* 1986, **10**, 221-227.

35. Spurzem JR, Romberger DJ, Von Essen SG: Agricultural lung disease. *Clin Chest Med* 2002, **23**, 795-810.

36. Stiernström EL, Holmberg S, Thelin A, Svärdsudd K: Reported health status among farmers and nonfarmers in nine rural districts. *J Occup Environ Med* 1998, **40**, 917-924.

37. Stordal E, Bjelland I, Dahl AA, Mykletun A: Anxiety and depression in individuals with somatic health problems. The Nord-Trondelag Health Study (HUNT). *Scand J Prim Health Care* 2003, **21**, 136-141.

38. Svensson HO, Vedin A, Wilhelmsson C, Andersson GB: Low-back pain in relation to other diseases and cardiovascular risk factors. *Spine* 1983, **8**, 277-285.

39. Thelin A, Jansson B, Jacobsson B, Strom H: Coxarthrosis and farm work: a case-referent study. *Am J Ind Med* 1997, **32**, 497-501.

40. Thelin A, Vingård E, Holmberg S: Osteoarthritis of the hip joint and farm work. *Am J Ind Med* 2004, **45**, 202-209.

41. Walker-Bone K, Palmer KT: Musculoskeletal disorders in farmers and farm workers. *Occup Med* (*Lond*) 2002, **52**, 441-450.

42. Wright D, Barrow S, Fisher AD, Horsley SD, Jayson MI: Influence of physical, psychological and behavioural factors on consultations for back pain. *Br J Rheumatol* 1995, **34**, 156-161.

43. Åstrand NE: Medical, psychological, and social factors associated with back abnormalities and self reported back pain: a cross sectional study of male employees in a Swedish pulp and paper industry. *Br J Ind Med* 1987, **44**, 327-336.