IN-DEPTH REVIEW

Musculoskeletal disorders in farmers and farm workers

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Farming is a physically arduous occupation and this places farm workers at potential risk of musculoskeletal disorders such as osteoarthritis (OA) of the hip and knee, low back pain (LBP), neck and upper limb complaints, and hand–arm vibration syndrome (HAVS). This review considers the epidemiological evidence concerning such risks. The strongest evidence relates to OA of the hip, for which the public health impact is likely to be considerable. There is also weaker, but suggestive evidence that farmers more often have knee OA and LBP than workers in occupations with fewer physical demands. Tractor drivers, in particular, seem to have more LBP. Relatively little information exists on the risks of soft tissue rheumatism in the limbs and neck. For some outcomes, the link with occupational risk factors (such as heavy loading of joints and whole-body vibration) is sufficient to suggest the course that future prevention should take, but for several outcomes more research is first needed.

Key words: Farmers; farm workers; hand–arm vibration syndrome; low back pain; musculoskeletal disorders; osteoarthritis.

Received 17 April 2002; revised 11 June 2002; accepted 11 September 2002

Introduction

Although frequently portrayed as idyllic, farming is an arduous profession. Among the many physical hazards and stressors are: lifting and carrying heavy loads; work with the trunk frequently flexed; risk of trips and falls on slippery and uneven walkways; risk of accidents caused by the sudden unpredictable actions of livestock; and exposure to whole-body vibration (WBV) from farm vehicles and hand-transmitted vibration (HTV) from chain saws and powered hand-tools. Some insight into the frequency of such exposures in Britain can be garnered from a survey of self-reported working conditions, commissioned by the Health & Safety Executive (HSE; see Table 1) [1], and from a new analysis we have conducted (Table 2), using data from a large community survey which characterized daily physical exposures across a range of occupations (see below for more details). It may be seen that use of appreciable force, lifting, digging and shovelling, and exposures to WBV and HTV are all more common in farmers than in other manual occupations.

The physical circumstances of their occupation render farm workers potentially vulnerable to musculoskeletal disorders (MSDs) such as osteoarthritis (OA) of the hip and knee, low back pain (LBP), upper limb disorders and hand–arm vibration syndrome (HAVS), as well as to the consequences of trauma (e.g. sprains, fractures and dislocations). In addition, there is some evidence to suggest that farmers may be more vulnerable to other rheumatological conditions, including rheumatoid arthritis (RA).

According to a survey of self-reported work-related illnesses in 1995 [2], an estimated 43 000 agricultural workers from Britain ascribe musculoskeletal symptoms to their work, including 27 000 with back pain, 10 000 with upper limb or neck complaints, and 11 000 with work-related musculoskeletal disorders (WMSDs) of the lower limb. However, for MSDs of slow onset or intermittent time course and those which may relate to cumulative long-term exposures, attribution of symptoms is difficult in the individual case, leading to a potential under- or overestimate of the number of work-related cases.

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Table 1. Physical exposures in farming, forestry and fishing, relative to other occupations (adapted from [1])

Exposure	*Prevalence in farmers relative to all occupations*	*P-value*
Ever in the job:		
had to use appreciable force	2.29	<0.05
used a vibratory tool	2.91	<0.05
sat/stood on a vibrating machine or vehicle	6.52	<0.05
had to work in awkward, tiring positions	1.24	n.s.[a]
had to repeat the same sequence of movements many times over	1.23	n.s.[a]
had to twist or stoop when lifting or moving heavy loads	0.98	n.s.[a]

[a]Not significant at the 5% level.

In this review, we consider the epidemiological evidence that work in farming causes or aggravates MSDs and estimate the likely scale of risk among farm workers.

Methods

To inform the review, we conducted an electronic search of the MEDLINE (1966–June 2001) and EMBASE (1980–June 2001) databases using subject heading and key-word search terms for farm, farmer, farming, agriculture, rural, tractor and vibration, in association with terms for arthritis (or OA), back pain, upper limb disorder and musculoskeletal pain. All of the abstracts were reviewed and relevant articles were retrieved. In addition, a search was made of several major reviews of WMSDs [3–9] known to the authors. The bibliographies of retrieved papers and reviews were checked for further relevant material. The findings are presented in three sections: OA of the hip and knee; LBP; and back pain in tractor drivers; with additional commentary on disorders of the upper limb and neck, HAVS and some other rheumatic disorders.

Also, we have conducted a supplementary analysis of MSDs in farm workers, using data from a survey (the National Survey of Vibration, 1997–8 [10]) in which we mailed questionnaires to 21 201 men and women aged 16–64 years. These adults had been selected at random from the age–sex registers of 34 general practices across Great Britain, including residents of rural general practices. Details of the survey and questionnaire have been published elsewhere [10–12]. Among other things, questions were posed about occupation, exposures at work during an average day (including estimated daily doses of HTV and WBV); regional pain over the past 12 months, including pain which prevented normal everyday activities (based on a modified Nordic questionnaire [13]); LBP which made it difficult or impossible to put on hosiery; attacks of cold-induced finger blanching; and tingling or numbness in the digits. Analysis was confined to those who held a job at the time the questionnaire was completed. The occupations of participants were classified according to the Standardised Occupational Classification 1990 or 'SOC90' [14]. Directly standardized estimates of the prevalence of regional pain (or exposure, as in Table 2) were calculated for farm workers, farm owners and farm managers (SOC90 unit groups 160, 169 and 900–902; n = 122) and compared with other blue-collar workers (n = 2424) and white-collar workers (n = 2228). The results on health are presented below.

Table 2. Prevalence of selected exposures in men who work on farms and in other male workers

	No. (prevalence %[a]) with exposure in		
Exposures	*Farm workers[b] (n = 122)*	*Blue-collar workers[c] (n = 2424)*	*White-collar workers[c] (n = 2228)*
In an average working day:			
lifting weights ≥25 kg by hand	98 (80.7)	1192 (49.4)	273 (12.5)
digging or shovelling	91 (74.6)	487 (20.2)	32 (1.4)
working with hands above shoulder height for >1 h/day	31 (25.8)	678 (28.1)	91 (4.4)
In past week:			
exposure to HTV with average minimum A(8) > 2.8 m/s^2	25 (23.5)	386 (17.4)	15 (0.7)
exposure to WBV with average minimum $eVDV_T$ > 15 $m/s^{1.75}$	29 (24.5)	94 (4.1)	4 (0.2)

$eVDV_T$, estimated personal vibration dose value.

[a]Standardized to the age of all male workers.

[b]SOC90 unit groups 160, 169, 900, 901, 902.

[c]Social classes IIIM, IV, V = blue collar; I, II, IIINM = white collar.

Findings

Osteoarthritis

Hip osteoarthritis

There is now compelling evidence [15–24] that farmers have an increased risk of hip OA (Table 3). Early case–control studies from Finland [15], Sweden [16,17] and France [25] suggested that farmers had higher rates of total hip arthroplasty for OA than other occupational groups (with a relative risk of ~2–3 for surgically treated disease). In a large Swedish cohort study, which included

Table 3. Risk of osteoarthritis in farm workers

Ref.	*Study population*	*Health outcome*	*Study design*	*Comparison*	*Findings*
Hip osteoarthritis					
[15]	919 hospital out-patients with OA found incidentally on X-rays	Hypertrophic or destructive OA, based on several radiological features	C	Farmers versus office workers	For mild/moderate OA, OR = 1.69, 95% CI = 1.11–2.60; for severe OA, OR = 2.49, 95% CI = 1.39–4.48
[16]	85 men on a waiting list for THA and 262 men from the same hospital who had an IVU for urinary symptoms	THA; JSN < 3 mm on X-ray	CC	Farm work versus others	For THA, OR = 1.75, 95% CI = 1.03–2.98; for JSN, OR = 1.94, 95% CI = 1.19–3.16
[17]	105 men undergoing THA and 222 male referents, selected at random from the Swedish national register	THA	CC	1–10 years farming versus <1 year >10 years farming versus <1 year Drove tractor regularly versus not Milked regularly versus not	OR = 2.1, 95% CI = 1.4–4.3 OR = 3.2, 95% CI = 1.8–5.5 OR = 2.2, 95% CI = 1.3–3.9 OR = 2.2, 95% CI = 1.3–3.7
[18]	250 217 blue-collar workers reporting the same job at census in 1960 and 1970; record linkage with 1981–1983 Swedish Hospital Discharge Register (37 720 admissions among farmers)	OA as discharge diagnosis	Cohort	Farmers versus MWs deemed to have a low physical workload	Men, OR = 3.78, 95% CI = 2.91–3.88; women, OR = 1.47, 95% CI = 0.86–2.85
[19]	1307 men from Stockholm county receiving a disability pension due to MSDs during 1979–1981 and 1984 versus 298 men randomly selected from a population register	OA hip as reason for pension award	CC	Farmers and forest workers versus jobs deemed to have a low physical workload	OR = 13.8, 95% CI = 4.0–48.1
[20]	245 cases and 294 referents identified from men at two English hospitals who had undergone an IVU in 1982–1987	JSN ≤ 2.5 mm ('severe' if THA or JSN ≤1.5 mm)	CC	10 years farming versus <1 year	For severe OA, OR = 2.0, 95% CI = 0.9–4.4
[21]	Population sample of 1231 men aged 60–76 from five English rural general practices (168 farmers versus 83 sedentary controls)	THA or OA on X-ray (JSN ≤ 1.5 mm)	C	Farmed at least 1 year versus controls 1–9 years farming versus controls ≥10 years farming versus controls	OR = 7.8, 95% CI = 1.8–33.8 OR = 4.5, 95% CI = 0.8–4.4 OR = 9.3, 95% CI = 1.9–44.3
[22]	Members of a Swedish farmers' safety association, aged 40–64, who had undergone colon X-rays (435) or IVUs (465) that could be found; films from 1260 age-matched urban referents	OA on X-ray (JSN < 4 mm and/or cysts or sclerosis)	CC	Farmers versus urban referents	For men, 8% versus 0.8%; for women, 1.3% versus 0.8%
[23]	269 cases and 538 community referents, matched for age, sex and place of residence; identified from consecutive radiographs of the pelvis and hip taken between 1986 and 1988 at hospitals in one Swedish county	OA on X-ray, JSN < 3 mm	CC	In agriculture (Y/N) Drive tractor (Y/N) Milk full-time (Y/N) Farmer >30 years versus never Farm labourer >30 years versus never	OR = 2.70, 95% CI = 1.94–3.77 OR = 2.05, 95% CI = 1.45–2.88 OR = 2.98, 95% CI = 2.07–4.28 OR = 3.82, 95% CI = 2.41–6.06 OR = 6.43, 95% CI = 1.83–22.52
Knee osteoarthritis					
[18]	250 217 blue-collar workers reporting the same job at census in 1960 and 1970; record linkage with 1981–1983 Swedish Hospital Discharge Register (37 720 admissions among farmers)	OA as discharge diagnosis	Cohort	Farmers versus MWs deemed to have a low physical workload	For men, OR = 1.46, 95% CI = 1.23–1.98; for women, OR = 1.36, 95% CI = 0.57–3.55
[19]	1307 men receiving a disability pension due to MSDs during 1979–1981 and 1984 versus 298 men randomly selected from a population register	OA knee as reason for pension award	CC	Farmers versus jobs deemed to have a low physical workload	OR = 5.3, 95% CI = 1.4–19.7
[24]	625 patients who had a total knee replacement in 1991–1993, identified through the Swedish Knee Arthroplasty Register; 548 referents, randomly selected from a population register	Primary OA leading to knee replacement	CC	Farmers versus unexposed to heavy jobs Farm workers versus unexposed to heavy jobs	For men, OR 3.2, 95% CI = 2.0–5.2; for women, OR 2.4, 95% CI = 1.4–4.1 For men, OR 1.4, 95% CI = 0.8–2.6; for women, OR 1.4, 95% CI = 0.8–2.6

OA, osteoarthritis; THA, total hip arthroplasty; JSN, joint space narrowing on radiograph; IVU, intravenous urogram. Study design: C, cross-sectional; CC, case–control. Comparison: WCWs, white-collar workers; MWs, manual workers. OR = odds ratio; CI = confidence interval.

250 000 people who had held the same blue-collar occupations in successive censuses, the risk of admission for hip OA among farmers was increased nearly 4-fold relative to occupations deemed to have a low physical workload [18].

However, this pattern could arise from difficulty in coping with hip OA, rather than a higher incidence of the disease. Self-employed farmers with hip disease might seek joint replacement more readily than other workers (referral bias), as the necessity of continuing in physically arduous work could be greater, the options for alternative deployment more limited. In Sweden, where a disability pension is available to farmers with hip OA, a particularly high rate of award [odds ratio (OR) = 13.8, 95% confidence interval (CI) = 4.0–48.1] was found relative to physically less demanding occupations [19] and this too might arise from self-selection rather than a higher incidence of disease.

This issue has been addressed using two broad study designs:

1. case–control studies in which OA has been identified radiographically on films taken for other purposes (e.g. imaging of the colon and intravenous urograms), rather than among those seeking help for their hip pain [20,22]; and
2. radiographic surveys that have sampled from the general population, rather than in those attending secondary care [21].

In each circumstance, a comparison of disease occurrence among farmers and other workers potentially offers a less biased estimate of the risks according to occupation.

Investigations based upon these approaches have consistently shown an excess risk of hip OA among farmers. A survey of the radiographs of Swedish farmers who had undergone X-rays of the urinary tract or colon found a prevalence of OA 10 times higher than in control films from the general population [22]. A similar study in Britain identified cases from intravenous urograms and found a doubled risk of severe OA in men who had farmed for >10 years when compared with controls [20]. In an update of an earlier Swedish case–control study, joint space narrowing was two to three times more common in agricultural workers, and more than six times more prevalent among men who had worked as farm labourers for >30 years [23]. Using a population-based approach, British men aged 60–76 years were sampled from the registration lists of five rural general practices [21]. Subjects with relevant symptoms (who had not had a hip replacement) had a new hip radiograph taken, or a recent one traced. The prevalence of moderate to severe radiographic hip OA (defined as a minimal joint space ≤1.5 mm or joint replacement for OA) was found to be higher in 168 farmers than 83 referents who had spent their entire careers in clerical work (OR = 7.8 overall and 9.3 for men with ≥10 years in farming). Comparable risk estimates have been found in several other surveys [19,22].

The precise cause of hip OA in farmers has not been defined, but potential risk factors include regular heavy lifting, prolonged standing and walking over rough ground and vibration from tractor driving. According to one survey [17], similar risks existed both for tractor driving and for milking, and in a second study [21] risk did not vary greatly according to farming activity. However, the findings are consistent with a growing body of more general evidence that individuals who spend a large proportion of their day performing activities that produce large hip joint compression forces are at higher risk of hip OA [18,26–29]. It has been estimated that as many as one in five farmers may eventually require hip replacement [21], emphasizing the large burden on the public health of this problem and the importance of limiting manual handling in agriculture as far as is reasonably practical.

Knee osteoarthritis

There have been fewer studies of farm working and knee OA (Table 3). A modestly increased risk (OR = 1.4–1.5) was found among farmers in a Swedish case-registry survey [18] that linked census data on occupation with hospital discharge diagnosis. However, the risk of knee OA leading to disability pensioning in Sweden was considerably increased (OR = 5.3 in farmers versus less physically demanding jobs [19]). And risk of OA leading to total knee replacement was increased 3-fold among male farmers in a recent case–control study based upon the Swedish Arthroplasty Register [24].

In general, the findings are suggestive of increased risk and are consistent with the growing number of studies linking knee OA with heavy physical activity, such as that required in farming [19,30–32]. Hence, the benefit of improved manual handling on farms may also extend to the prevention of disabling knee disease.

Low-back pain

Given the physical ('back-breaking') demands of farm work, it might be expected that LBP would be a particular risk for farmers and there is some epidemiological evidence to support this (Tables 4 and 5). In community surveys from the USA [33], Belgium [34] and Finland [35], simple LBP was more prevalent among farm workers than white-collar referents, the risk being comparable to that of blue-collar workers [35].

Less evidence is available on the severity of LBP in farmers and the risk of disablement, but in a second US study [36] only small differences between farmers and manual workers were found in the prevalence of

Table 4. Surveys of low-back pain in farmers and agricultural workers

Ref.	*Study population*	*Definition of back pain*	*Study type*	*Comparison*	*Findings*
[33]	Probability sample of 1414 workers from the US Quality of Employment Survey, 1972–1973	'Trouble' with the back or spine in past year	C	Farmers and farm labourers versus WCWs	35% versus 12%, OR = 5.2, 95% CI = 1.6–17.0
[19]	1307 men from Stockholm county receiving a disability pension due to MSDs during 1979–1981 and 1984 versus 298 men randomly selected from a population register	Low-back disorder as reason for pension award	CC	Farmers and forest workers versus jobs deemed to have a low physical workload	OR = 5.6, 95% CI = 1.8–18.6
[34]	Probability sample of 3829 Belgians aged ≥15 years, stratified by age, gender and social class	Lifetime or daily LBP	C	Farmers versus desk workers	Lifetime risk, OR = 1.49, 95% CI = 0.88–2.52; daily LBP, OR = 0.92, 95% CI = 0.47–1.81
[36]	113 377 workers from a multistage probability sample of US households (the National Health Interview study, 1986–1990); included 2681 farmers	Current LBP which had lasted ≥3 months	C	Farmers and farm managers versus MWs versus WCWs	For BP, 7.8% versus 6.9% versus 6.0%; for disc lesion, 2.4% versus 2.6% versus 2.5%
[35]	7544 adult male working Finns, selected at random from a national population register in surveys between 1988 and 1990	LBP in the past 30 days; LBP leading to medical consultation in past 12 months	C	Farmers versus WCWs	For male farmers, LBP, OR = 2.1, 95% CI = 1.6–2.9; consultation, OR = 1.9, 95% CI = 1.2–2.9
				MWs versus WCWs	For male manual workers, LBP, OR = 1.8, 95% CI = 1.5–2.3; consultation, OR = 2.1, 95% CI = 1.6–2.8
[37]	Incident episodes of hospitalized sciatica or herniated disc over 11 years of follow-up among a community sample of 57 000 Finnish adults	Herniated lumbar disc alone	C	Farmers versus WCWs	Men, RR 0.8 ($P < 0.05$); women, RR 1.4 ($P < 0.05$)
		Herniated disc and/or sciatica			Men, RR 1.5 ($P < 0.05$); women, RR 1.4 ($P < 0.05$)
[39]	366 farmers interviewed in 1979 and again in 1992	12 month prevalence of LBP	L	Full-time versus part-time farming (in 1992)	In men: LBP in 20% versus 14%; sciatica in 18% versus 6%
				≥16 hectares versus <16 hectares (in 1979)	LBP in 21% versus 13%; sciatica in 13% versus 10%
				Crop husbandry versus dairy farming	LBP in 23% versus 17%; sciatica in 16% versus 11%
				Adjusted risk, crop husbandry versus dairy	OR = 2.4, 95% CI = 0.6–9.2
[40]	759 farmers from a stratified probability sample of 458 farms in Colorado	Back pain lasting for 7 consecutive days in the past 12 months	C	Farming/ranching versus other activities	OR = 1.66, 95% CI = 1.17–2.36
				10–29 years versus 1–9 years in agriculture	OR = 1.62, 95% CI = 1.14–2.30

Study design: C, cross-sectional; CC, case–control; L, longitudinal. Comparison: WCWs, white-collar workers; MWs, manual workers. OR = odds ratio; CI = confidence interval.

persistent LBP (lasting at least 3 months); in a Belgian survey [34], daily LBP was not more common among farmers than in desk workers, and in our own study (Table 5) the age-standardized prevalence of troublesome LBP (that made it difficult or impossible to put on hosiery) was only slightly higher in farm workers (41%) than in other manual (38%) or non-manual workers (27%). In a Finnish population survey, farmers more often consulted a medical practitioner with back pain than did 'upper' white-collar referents—the risks being similar, however, to those for manual workers in general [35]; but in a second Finnish study [37], a hospital discharge diagnosis of sciatica or prolapsed lumbar intervertebral disc was not significantly more common in agricultural workers than white-collar workers.

A mixed message emerges from the data on compensation awards for back disorders. In Sweden, for example, farmers were at least five times more likely to receive a pension award for LB disorder than other men in less physically arduous work [19]. Analysis of workers' compensation data from the US [38] showed that the rate of claims for back strain or sprain among agricultural workers (0.9/100 employees/year) was greater than that among finance workers (0.2/100 employees/year), but not as great as recorded in construction (1.6), mining (1.5) and general manufacturing (1.0).

Finally, in some occupational surveys, internal comparisons have been made according to hours worked, years in farming, main farming duties and other proxies of exposure; and these surveys lend some weight to the evidence of specific physical risk. In a longitudinal study of Finnish farmers [39], the prevalence of LBP after

Table 5. Prevalence of upper limb, neck and back pain in men who work on farms and other male workers

	No. positive (%[a]) in		
Symptoms in the past 12 months	*Farm workers[b] (n = 122)*	*Blue-collar workers[c] (n = 2424)*	*White-collar workers[c] (n = 2228)*
Pain preventing normal activity in the:			
neck	5 (4.0)	194 (8.4)	164 (7.4)
shoulder(s)	14 (11.8)	224 (9.7)	151 (7.1)
elbow(s)	1 (0.9)	109 (4.8)	72 (3.2)
wrist(s)/hand(s)	4 (3.4)	193 (8.3)	113 (5.2)
hip(s)	14 (11.5)	111 (4.8)	71 (3.3)
knee(s)	12 (9.9)	248 (10.7)	186 (8.7)
Troublesome LBP[d]	48 (41.3)	882 (37.5)	594 (26.7)

[a]Standardized to the age of all male workers.

[b]SOC90 unit groups 160, 169, 900, 901, 902.

[c]Social classes IIIM, IV, V = blue collar; I, II, IIINM = white collar.

[d]LBP that made it difficult or impossible to put on hosiery.

13 years of follow-up was greater in those who had farmed a greater acreage at baseline and in those who undertook crop husbandry as compared with dairy farming (OR = 2.4, 95% CI = 0.6–9.2), while those who still worked full-time at follow-up more often reported LBP and sciatica than those who worked part-time. And in a survey of farmers from Colorado [40], LBP was more prevalent in those who had farmed long-term (OR for 10–29 years versus 1–9 years, 1.62, 95% CI = 1.14–2.30).

Farm owners and workers (who tend to be self-employed or paid piece-work rates) may be more motivated to keep gainfully employed and to disregard minor symptoms than other workers, in which case their employment circumstances may mitigate against the reported disability of BP. In general, psychosocial as well as physical risk factors are assumed to underlie the development and reporting of BP [41], while continuing physical activity is one strategy now advocated to counter its effects [42].

Whatever its origin, the impact of LBP on ability to execute farming duties may, none the less, be considerable—as evidenced by a survey of male farmers from Colorado [43], 37% of whom reported having to make 'major changes in work activity because of back pain' in the past 12 months. Thus, there is an imperative to help farmers by reducing the physical demands of their work.

Low-back pain and tractor driving

A specific association between LBP and tractor driving has been mooted for more than 40 years [44]—the body of evidence now being large enough to merit separate consideration (Table 6). Many early surveys on the topic [45–48], which focused on symptoms and radiographic changes in index cases, were limited by the lack of control data. During the 1990s, however, several higher quality, more comprehensive surveys were conducted and these included information on controls [49]. When compared with other agricultural workers in Holland, tractor drivers experienced more recurrent LBP (OR = 2.0) and sciatica (OR = 1.6) and had a higher incidence of prolonged sickness absence ascribed to back disorders (incidence density ratio 1.3 for simple BP and 3.1 for a disc lesion) [50,51]. The highest relative risk was found for long-term sick leave due to intervertebral disc disorders, where the effect was strongly linked to the estimated dose of vibration [for >5 versus ≤0.5 (years m^2/s^4), OR = 7.2, 90% CI = 0.92–17.9]. An Italian survey by Bovenzi and Betta [52] found more sciatica in the previous year (OR = 3.9) and LBP over various time periods (e.g. OR = 1.3 for previous week to 3.2 for lifetime) among male tractor drivers than in revenue office workers. In a smaller British survey [53], LBP was more prevalent among tractor drivers than poultry workers. Similarly, back pain was more prevalent among 50 tractor drivers from northern India compared with other farmers, individually matched on several characteristics, such as age, sex, extent of land-holding and principal farming practices [54]. In contrast, however, a large British community survey [55], including 255 male tractor drivers and some 4800 other workers, demonstrated no association with LBP (OR = 0.9, 95% CI = 0.8–1.1) and a negative association with sciatica (OR = 0.6, 95% CI = 0.4–0.9). A negative association has also been reported between tractor ownership and neck pain in Sweden [56]—see below.

There is a substantial body of epidemiological and biodynamic evidence to suggest that exposure to WBV at the doses likely to be encountered by farmers driving tractors is associated with LBP [3,49,57]. However, tractor drivers also undertake a range of other manual handing activities, have to twist in their seats, and have to

Table 6. Relationship between back pain and driving a tractor

Ref.	*Study population (exposure level)*	*Study type*	*Back pain outcome*	*Findings*
[50]	450 tractor drivers and 110 other agricultural workers (a_V 0.72 m/s^2, 10 years)	C	Lifetime LBP	13% versus 12%, OR = 1.0, 90% CI = 0.6–1.7
			Regularly experienced LBP	31% versus 9%, OR = 2.0, 90% CI = 1.3–3.1
			Sciatic pain	19% versus 13%, OR = 1.6, 90% CI = 0.9–2.0
[51]	423 tractor drivers and 375 workers with minimal or no exposure (a_V 0.72 m/s^2)	RC	Sickness absence >28 days due to a back disorder	For disc lesion, IDR 3.1, 90% CI = 1.2–8.3; for BP, IDR 1.3, 90% CI = 0.9–1.9
[52]	1155 male tractor-driving members of an agricultural association versus 220 revenue office workers (a_V 1.06 m/s^2, 21 years)	C	Lifetime LBP	81% versus 42%, OR = 3.2, 95% CI = 2.1–5.2
			LBP in past year	72% versus 37%, OR = 2.4, 95% CI = 1.6–3.7
			LBP in past week	31% versus 20%, OR = 1.5, 95% CI = 1.0–2.3
			Sciatic pain in past year	16% versus 4%, OR = 3.9, 95% CI = 1.8–8.7
[53]	100 tractor drivers versus 31 poultry workers (a_{WZ} 0.35–1.45 m/s^2, 16 years)	C	Lifetime LBP	64% versus 48%
			LBP in past year	46% versus 16%
[54]	50 tractor drivers from two villages in North India with ≥5 years of driving versus 50 other farmers matched for age, sex, race, land-holding and work routine	C	LBP in past 2 weeks	28% versus 4% (P = 0.01)
			LBP in past year	24% versus 14%
			Lifetime LBP	58% versus 36% (P = 0.03)
[55]	Community survey based upon random samples from 34 British general practices (included 255 male tractor drivers and 4800 other male workers)	C	LBP over past year	For LBP, OR = 0.9, 95% CI = 0.8–1.1
			LBP radiating to below the knee	For sciatica, OR = 0.6, 95% CI = 0.4–0.9

RC, retrospective cohort study; OR, odds ratio; CI, confidence interval; IDR, incidence density ratio.

get in and out of awkwardly sited cabins. Thus, the potential exists for confounding by other ergonomic factors. But the survey by Bovenzi and Betta [52], which was thorough in its attention to concurrent ergonomic exposures, such as bending and twisting, back trauma and postural load, found an association with estimated dose of WBV after adjustment for these other factors.

Other musculoskeletal disorders

Neck and upper limb complaints

There have been few surveys of neck and upper limb pain which provide evidence specifically on farmers. But using data from the National Survey of Vibration [10], we have estimated the prevalence of regional pain that limited activity and compared male farm workers (farm owners, farm managers and farm hands) with other men in blue- and white-collar jobs (Table 5). Neck, elbow and wrist pain were all less prevalent among the farm workers from this study, although shoulder pain was more common (12 versus 7% in white-collar men).

In contrast, although no separate data were presented on farmers, or on pain at other sites, the risk of chronic severe neck pain in a Finnish study—the Mini-Finland Health Survey [58]—was found to be higher in agricultural workers than among those from other jobs (OR = 1.96, 95% CI = 1.48–2.59) and a survey by Manninen *et al.* [56] found that neck pain was positively associated with the area of arable land formerly farmed in retired farmers under long-term follow-up.

Information on pain at other sites is even more sparse, being related to allied activities in which farmers sometimes engage. Higher risks of shoulder pain have been reported in two surveys of orchard farmers [59,60], one of glasshouse workers [61] and one of foresters [62]; foresters also had excesses of epicondylitis (OR = 4.9) and carpal tunnel syndrome (OR = 21) relative to manual controls in one Italian survey [62], and arm pain was found more commonly in milkmaids than in female nursing assistants in another survey [63], with ORs of 1.3–1.8. These findings are consistent with the known risk factors for MSDs of the upper limb and neck—working with the arms elevated, static loading, forceful exertion, repetitive work and heavy lifting [3]—all of which are likely to present in the daily working lives of farm workers, but at present there is insufficient epidemiological evidence to define farmers as a group at special risk of upper limb disorders.

Hand–arm vibration syndrome

Similarly, the risk among farm workers from HTV is unclear. Forestry workers incur substantial exposure to HTV from chain-saws and the risk of HAVS in this occupation is well established and quantified [44]. Farmers are exposed to HTV less often, although many undertake some forestry work, or use powered vibratory tools in repair and maintenance work on their farms. The risk of HAVS has not been quantified in this group, but data are available from the National Survey of Vibration (Table 2). Clearly, male farm workers can, and quite often do, incur exposure to HTV that may pose a significant risk of HAVS, and moderately higher risks of cold-induced finger blanching and sensorineural symptoms were found in farm owners, managers and workers from the survey, with prevalence ratios of 1.2–2.6 in comparison with unexposed occupations [64].

Fibromyalgia

In one population survey of 7217 adults in the Mini-Finland study [65], fibromyalgia was substantially more common among agricultural workers (1.48%) than among industrial workers (0.46%), service workers (0.77%) or white-collar professionals (none of 1596 subjects). The survey also reported a stronger association between fibromyalgia and OA (e.g. OR = 11.4, 95% CI = 6.1–21.3 for knee OA) than that explained by the relationship of OA with agricultural work. However, these findings have not been tested so far in other studies and are currently unexplained.

Rheumatoid arthritis

Rheumatoid arthritis (RA) also seems to be more common in farmers, but for reasons that are unclear. In 1970, a cross-sectional survey from Sweden [66] found that outdoor occupations with high physical loads were over-represented among patients with RA, and in a subsequent cohort study [67], farmers were found to have a 30% greater risk of developing RA than other workers. Among men, risk was associated with exposure to organic solvents and pesticides—both experienced in agricultural work—but no information was provided as to which specific chemicals and formulations were implicated.

More recently, a case–control survey [68] compared 102 cases of RA attending a university hospital with 248 community referents. For men, occupations at greater risk included farmers and farm workers (OR = 1.8, 95% CI = 1.0–3.5), but the same association was not found among women. Seropositive RA was linked with exposure to crops (OR = 1.9, 95% CI = 0.7–4.9) and pesticides in general (OR = 1.6, 95% CI = 0.5–5.6), but not with fertilizers (OR = 0.9). In a separate analysis of proportionate occupational mortality for men from Washington State [69], male farmers had an excess risk of RA as a mentioned cause of death (74 deaths observed versus 53 deaths expected, a proportional mortality ratio of 140).

The reason for this association is unclear. In the hospital-based series, referral bias may have contributed, as farmers who find themselves functionally limited by symptoms of RA may seek earlier diagnosis and treatment than members of some other occupations. However, the finding of an association in studies of different design makes bias a less likely explanation. No plausible mechanisms have been proposed to explain the possible link with organic solvents, pesticides and crops, and no data have been presented so far on which among a heterogeneous group of chemicals might be responsible, but this remains an area of active research inquiry.

Conclusions

Farm workers are exposed to a variety of physical hazards. As a group, they are at particular risk of accidental injury and certain categories of MSD. The strongest evidence of excess risk exists for OA of the hip and the public health burden arising from this outcome is considerable. Lesser, but suggestive evidence exists that farmers as a group are more likely than workers in less physically demanding work to have knee OA and LBP. Tractor drivers, in particular, seem to have more BP. There is less information on the risks of soft tissue rheumatism in the limbs and neck.

For some outcomes, a link can probably be made with potentially modifiable risk factors, such as heavy loading of joints and WBV, and the course that preventive action should take is apparent. In other outcomes, such as RA, more research is first needed.

Awareness of farmers' needs is growing among providers of occupational health and safety services. In future, the farming community requires better information on health risks and on how and when to call upon advice from safety professionals. The feasibility of organizing occupational health services for these small rural businesses has already been explored in Scandinavia [70] and a case exists for a similar British initiative.

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