UNIVERSITY OF SOUTHAMPTON

FACULTY OF MEDICINE, HEALTH AND LIFE SCIENCES

SCHOOL OF MEDICINE

HEALTH AND WORK IN RURAL POPULATIONS

(ONE VOLUME)

The Welsh Borders

Dr Christine Lorraine Solomon

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ABSTRACT

UNIVERSITY OF SOUTHAMPTON
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<u>Doctor of Philosophy</u>

HEALTH AND WORK IN RURAL POPULATIONS
by Christine Lorraine Solomon

This project was designed to investigate symptoms associated with pesticide exposure during agricultural work; in particular the proposed long-term effects of OP pesticide exposure. I conducted a large postal survey, in three agricultural areas, Devon, the Welsh Borders and Lincolnshire. The sample included all men aged between 25 and 69 years who had a postal address within defined boundaries. In order to disguise the prime purpose of the survey the questionnaire included questions on several work related exposures and health outcomes including mental health, respiratory heath, musculoskeletal problems, accidental injury and health related job loss. The results of analyses relating to these outcomes in agricultural workers are also presented.

Concerning pesticides, our main findings among agricultural workers were that acute symptoms shortly after pesticide use were common, but there was no evidence of a syndrome specific to sheep dip use. Long term symptoms, of the type that have been associated with OP use, were common in both users of sheep dip and in non-users. There was a strong association of tendency to somatise with both acute and longer term symptoms, suggesting that psychosomatic factors could have an impact on symptom reporting. Among users of sheep dip, amount of use was associated with short-term and longer-term symptoms.

Accidental injury was common among agricultural workers but types of injury were similar to that in non-agricultural occupations. Estimated accident rates from this study were considerably higher than rates for accidents reported under RIDDOR, particularly among self-employed agricultural workers.

Regarding other health problems, some were found to be more common among agricultural workers than in other occupations, particularly hip OA and Raynaud's phenomenon. However, despite recognised risk factors in agricultural work, hearing difficulty, hernia and anxiety and depression were similar in prevalence to that in non-agricultural workers, and hay fever and skin cancer were reported less in agricultural workers. Men were less likely to have left an agricultural job because of ill health than other occupations.

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Authors Declaration

I declare that this thesis is the result of work I have done whilst registered in candidature at the University of Southampton. The thesis is based on my own original work that has been undertaken by me with the support and assistance of others, as indicated in the acknowledgements. No material in this thesis has been submitted for another degree.

Publication relating to work for this thesis

Solomon C. Accidental injuries in agriculture in the UK. *Occupational Medicine* 2002; **52(8)**:461-466

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ABBREVIATIONS AND ACRONYMS

A&E	Accident and Emergency department in hospital
BCC	Basal cell carcinoma
BSI	Brief Symptom Inventory
CES-D scale	Centre for Epidemiological Studies-Depression scale
CDSR	Cochrane database of systematic reviews
CI	Confidence interval
CIS-R	Revised Clinical Interview schedule (for psychiatric morbidity)
COPIND	Chronic organophosphate induced psychiatric disorder
CVS	Cardiovascular system
DARE	Database of Abstracts and Reviews
DEFRA	Department of the Environment, Food and Rural Affairs
DWP	Department of Work and Pensions
EEG	Electroencephalogram
EPIDERM	Occupational reporting scheme for dermatologists
EMG	Electromyogram
GP	General practitioner
HAVS	Hand-arm vibration syndrome
HR	Hazard ratio
HSE	Health and Safety Executive
HTV	Hand transmitted vibration
HAD Scale	Hospital anxiety depression scale
IFN	Interferon
IHD	Ischaemic heart disease
IL	Interleukin
IOM	Institute of Occupational Medicine
IPS	Interpersonal sensitivity
IQR	Interquartile range
IRR	Incidence risk ratio
LFS	Labour Force Survey
NFU	National Farmers Union
NTE	Neuropathy target esterase
OA	Osteoarthritis
ODIN	Occupational Disease Intelligence Network

ODTS	Organic dust toxic syndrome
ONS	Office for National Statistics
OP	Organophosphate
OPCS	Office of Population, Censuses and Surveys
OPRA	Occupational Physicians Reporting Activity
OPIDN	Organophoshate induced delayed neuropathy
OSSA	Occupational Surveillance Scheme for Audiology Physicians
OR	Odds ratio
PCT	Primary care trust
PIAP	Pesticide Incidents Appraisal Panel
PMR	Proportional mortality ratio
PON1	Human serum paroxonase
PPE	Personal protective equipment
PPSA	Patient Practitioners' Services Agency
PR	Prevalence ratio
PRR	Proportional registration rate
PSD	Pesticide Safety Directive
PVD	Peripheral vascular disease
PY	Person years
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
RSI	Repetitive strain injury
SMR	Standardised mortality ratio
SWORD	Surveillance of Work Related Respiratory Disease
SWI	Self reported work related illness
Th cells	T helper cells
VMD	Veterinary Medicines Directive
VWF	Vibration white finger
WBV	Whole body vibration
Whitley Index	Whitley Index Dimensions of Hypochondriasis

PREFACE

This thesis describes a project the overall aim of which was to investigate the health of farmers in relation to work related exposures. Primarily the project was designed to investigate symptoms associated with pesticide exposure during agricultural work; in particular suspected long-term effects of organophosphate (OP) pesticide exposure. It also explored associations between various other occupational exposures and health outcomes in agricultural workers including accidental injury, health related job loss, mental illness, respiratory disease and musculoskeletal disorders.
The work was initiated following a report from a Department of Health Working Group on Organophosphates.[18] Their recommendations for further research included studies on the epidemiology of chronic illnesses that people in the UK have attributed to OPs. Other research questions identified as a priority were about the frequency and causes of "dipper's flu" and about whether a small sub-group of exposed persons could be identified in whom low level exposure to OPs caused disabling neurological and psychiatric illness.

However there are also important gaps in our knowledge about other aspects of health and work in the agricultural industry. Accidental injury in agriculture is recognised as an important problem and an area in which there is potential for prevention, but routine reporting of non-fatal injuries is known to be incomplete, and there are few epidemiological studies so important hazards of susceptible groups may have gone unrecognised.

Musculoskeletal problems are important in agricultural workers. The prevalence of hip osteoarthritis is relatively high compared to that in other occupational groups, but there is less information about other musculoskeletal problems in UK farmers. Likewise the prevalence of mental health problems and respiratory problems compared to other occupational groups is not clear.

In order to address these issues I conducted a large postal survey, in three agricultural areas, Devon, the Welsh Borders and Lincolnshire. The sample included all men aged between 25 and 69 years who had a postal address within defined boundaries. The questionnaire included questions on personal factors, lifetime work exposures and health outcomes.

CHAPTER 1: BACKGROUND – AGRICULTURE IN THE UK

1.1 Nature of Agriculture in the UK

1.1.1 Importance

Approximately 77% of the total area of the four countries of the UK is agricultural land, according to the June 2001 Agricultural Census.[1] Despite a decline in the number of livestock and area of land farmed in recent years, the UK is still 62% self-sufficient in all food, and almost 75% self-sufficient if food types not normally produced in the UK are excluded from the denominator.[2]

1.1.2 Types and Geographical Distribution

The type of farming undertaken in a particular area is influenced by the nature of the landscape, type of soil and climate. Table 1.1 illustrates differences in land use in England and Wales.

Table 1.1 Use of agricultural land in England and Wales[3]

	Crops	Grass & rough grazing	Forest	Urban	Other (roads, tracks)
England	30%	38%	8%	16%	8%
Wales	3%	76%	12%	6%	3%

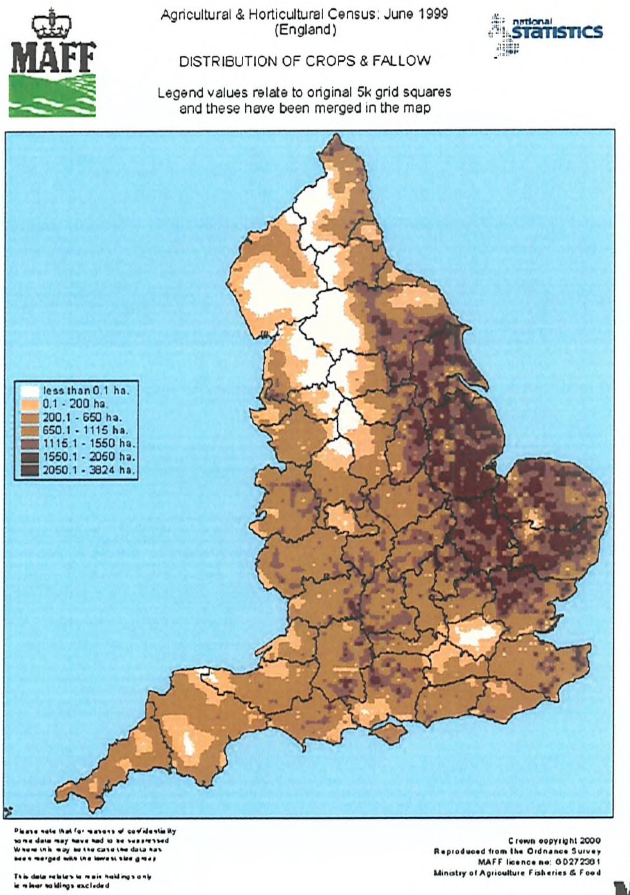
Of the total area of agricultural holdings in the UK, 24% is used for crops, 37% as grassland and a further 24% for rough grazing.

In 2002 wheat and barley accounted for 65% of the land used for crops. A further 9% of the cropped land area was used for oil seed rape, 6% for peas and beans, 4% for sugar beet, 8% for horticulture and 9% for other crops including potatoes and brassicas.

Livestock on British farms comprise mainly sheep, dairy and beef cattle, pigs and fowl. In 2000 there were over 40 million sheep and lambs in the UK. (see table 1.2)

Figures 1.1 and 1.2 illustrate the distribution and density of crops and fallow and sheep farming in England. Arable farming predominates in the east of England whereas the majority of sheep farming is in the north and south west.

Figure 1.1
Distribution and density of Crops and Fallow



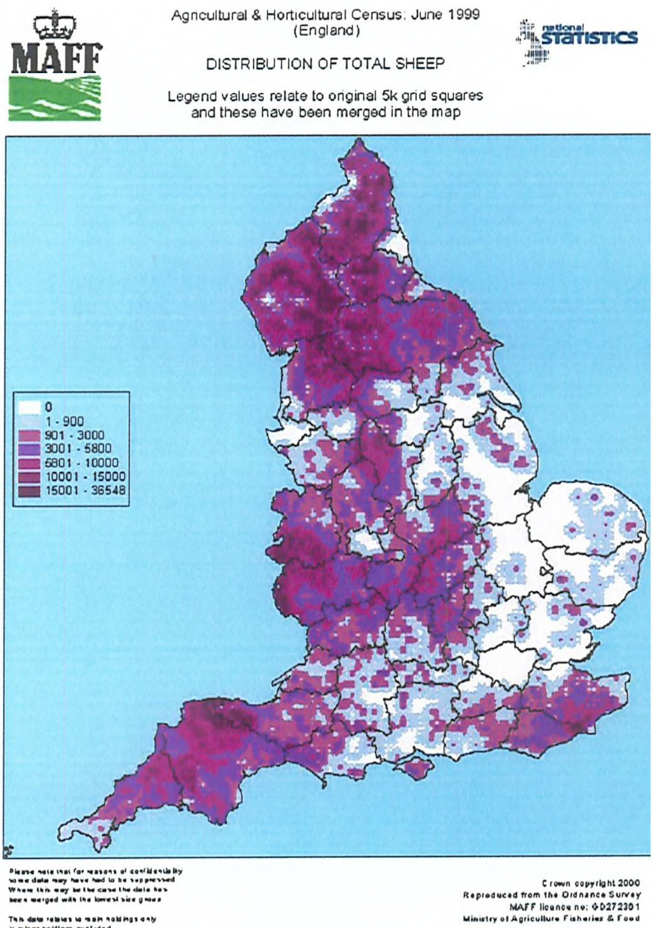
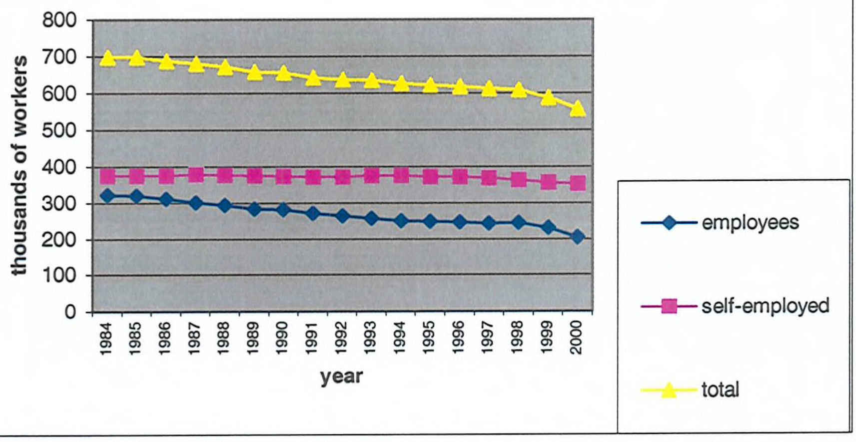


Figure 1.2
Distribution and density of total sheep

1.1.3 Trends in agricultural activity

The total agricultural workforce, particularly employees, has been falling since the 1980s (figure 1.3).[1] According to the National Farmers Union (NFU) nearly 18,000 agricultural workers in the Britain lost their jobs in 2002, and from 1999 to 2001 there were over 60,000 job losses. In England alone, in the six years to 2002 there were more than 67,000 job losses[4].

Figure 1.3 Labour force in agriculture in the UK 1984-2000



There was about a 10% decrease in the area of land used for growing crops over the period from 1990-2001 (some 500,000 hectares), and greater reductions in numbers of pigs, sheep and cattle farmed. However poultry farming increased. (Table 1.2) More recent statistics suggest that these trends are continuing [5].

Table 1.2 Livestock numbers in the UK 1990-2, 2000 and 2001 (in thousands)

	1990-2 (average)	2000	2001	% change 1990/2 -2001
cattle and calves	12 040	11 135	10 602	- 12%
sheep and lambs	44 392	42 264	36 716	-18%
pigs	7 650	6 482	5 845	-24%
fowl	126 075	154 504	163 875	+30%

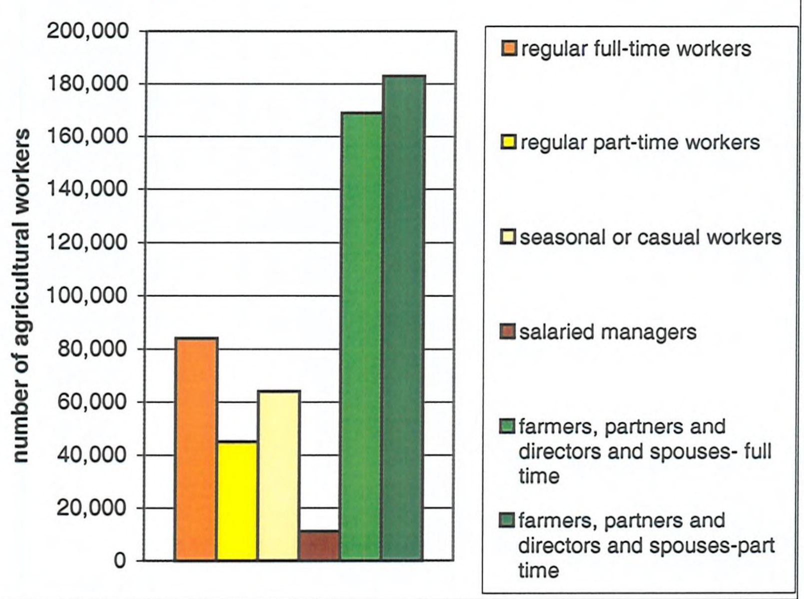
Source DEFRA 2002: summary statistics [2]

The management of foot and mouth disease has influenced numbers of livestock, but they had been falling prior to February 2001 when the most recent outbreak was first recognised.

1.1.4 Current labour-force: employees and self-employed

During 2001 the agricultural workforce, including spouses of farmers, partners and directors, was 550,000 persons, 2.2% of the total workforce in employment. Figure 1.4 illustrates the distribution by employment status. In 2000 there were approximately 1.5 times as many self-employed workers as employees.[1]

Figure 1.4 Agriculture in the UK in 2000



1.2 Impact of work on health

1.2.1 Agricultural work

Agricultural work, by its nature, is relatively hazardous. Among other things, it entails risks of physical injury from machinery and animals, poisoning by toxic chemicals, musculoskeletal disorders from heavy physical work, infections acquired from animals, respiratory disease from allergic responses to dusts, skin cancer from exposure to sunlight and psychological stress from economic pressures. Long hours spent working tend to increase exposure to hazards. 66% of farmers in Britain regularly work over 60 hours per week, compared to the national average of 38 hours per week.[4]

Some of the main hazards associated with agricultural work are listed in table 1.3. Evidence relating to these hazards will be discussed in chapter 2.

Table 1.3 Main hazards and health effects associated with agricultural work

Hazard	Possible Health Effects
Physical activity e.g. lifting, climbing, walking over fields	Back pain, hip osteoarthritis, knee osteoarthritis, accidental injury, hernia
Use of machinery and tools Driving tractors and off road vehicles	Accidental injury, noise-induced hearing loss, back pain, knee/hip pain, hand-arm vibration syndrome
Animal handling	Accidental injury, infections, respiratory disease
Chemicals e.g. pesticides, disinfectants, veterinary medicines	Acute poisoning, longer term effects of poisoning, dermatitis
Organic materials e.g. hay, grain dust	Respiratory disease
Outdoor work	Sunburn, skin cancer
Economic and seasonal pressures	Psychological stress, suicide
Firearms	Noise–induced hearing loss, suicide, accidental injury

1.2.2 Nature of employment and occupational health and safety

There are a number of characteristics of the agricultural industry that inhibit effective occupational health and safety. Most farmers are either self-employed or work in small businesses, and very few have access to occupational health services. The physical work environment is variable, on a day-to-day basis and seasonally, thus individuals tend to be generalists working on a variety of activities. At busy times, particularly when casual labour is used, safety training may not always be adequate. In addition some hazards in the farm workplace, are less predictable than for other industries (e.g. animals).

1.3 Non-occupational influences on health

As well as being influenced by occupational hazards, the health of agricultural workers will also be determined by aspects of their lifestyle such as smoking habits, alcohol consumption, leisure activities and access to and use of general health services. There is little information on how these factors differ in British agricultural workers as compared with other occupational groups.

There is some historical data available on smoking in Britain and information from other countries. In England and Wales in the 1970s and 80s, the proportion of current smokers among agricultural workers was lower than in most other occupational groups.[6] Also, a relatively low prevalence of smoking has been reported among farmers in the USA[7] and more recently in Sweden.[8] In Sweden the low prevalence of ischaemic heart disease in farmers has been attributed to their low prevalence of smoking.[8]

It is possible that growing up on a farm may be protective for asthma in later life. In several studies early exposure to farm life and animal contact appeared to be protective against development of asthma and hay fever.[9-11]

There is limited data on use of health services by farmers compared to other occupational groups. There is some evidence that farmers consult their GPs for medical problems at least as often as non-farmers. A small retrospective study in a Lancashire practice, over a five year period, of GP consultations by men currently working as farmers compared to age matched controls, reported that farmers were significantly more likely to consult for infections, disorders of the nervous system, skin disorders and external causes of injury than the control group. However they were less likely than the control group to visit the surgery for health promotion.[12] In another study of male patients who had committed suicide there was no significant difference between farmers and (age matched) non-farmers in numbers in contact with their general practitioner or mental health services during the 3 months before death, although farmers were more likely than non-farmers to have presented with only physical symptoms and not psychological.[13]

1.4 Impact of health on work

Very little is known about the impact of illness on the capacity of farmers to work in the UK. Physical impairment could be more of a handicap to agricultural workers than workers in many other occupations because of the physical nature of the work. A survey of farmers in England and Wales found that almost one third reported health problems that interfered with their work[14]. One Finnish study looked at the issue in a bit more detail. Of 577 farmers interviewed only 44% perceived their work ability as "good". The most common reason for a moderate or poor work ability was somatic disease (45%) or factors associated with ageing (29%). Musculoskeletal problems were the most common chronic disorders.[15]

Estimates of sickness absence in Great Britain, by occupational group, have been derived using data gathered from questions in the Labour Force Survey (LFS) during a reference week in each of the years 1987 to 1991, and recorded sickness absence in agricultural workers was only marginally higher than the national average.[16] Like other occupational groups in which physical work is important, the ratio of one to six day absences compared to absences greater than eight weeks was low i.e. there was a tendency to longer absence.[16] This pattern of sickness absence was also suggested by more recent data on absence following injury.[17] (see section 2.10) However, it is not clear to what degree sickness absence reflects true morbidity, nor what proportion of farmers is forced to leave work through ill health. There are a few studies on specific types of health problem and capacity to work, discussed in section 2.10, but they were from countries other than the UK, and may not be generalisable.

The organisation of agricultural work (i.e. a large proportion of the workforce self-employed, working in small businesses, or employed as casual or contract labour with limited occupational health input) makes it difficult to get information on the impact of health on work. It is possible that these factors, together with seasonal pressures, deter individuals from taking time off work, and make alternative employment difficult.

1.5 Conclusion

Agriculture is an important industry in the UK. In theory there are many potential hazards and detrimental health effects. However organisation of the industry makes it difficult to obtain useful information about how farming influences health. Because of the physical nature of the work there may be special problems with fitness for work and sickness absence, but there is little information from routine data to indicate that this is so.

The following chapter discusses information on the health effects of agricultural hazards in more detail.

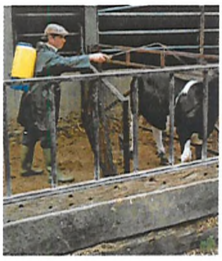
CHAPTER 2: BACKGROUND LITERATURE

As described in chapter 1 there are various hazards associated with work in agriculture. This chapter discusses some of the hazards and evidence concerning associated health effects. Information sources for the following literature review and for data presented in chapter 1 included published reviews, research papers, reports and statistics, and other reports and statistics from the Health and Safety Executive (HSE), Office for National Statistics (ONS), Department of the Environment, Food and rural affairs (DEFRA) and National Farmers Union (NFU) available electronically, or obtained following a direct enquiry. A summary of data sources relevant to agriculture is given in appendix 10.

MEDLINE was used to search for literature using simple combinations of key words appropriate to individual topics such as farmers and pesticides, agriculture and asthma. Bibliographies to papers also provided key references. Recent reviews for each health area were obtained and used (if they existed) in conjunction with original papers. Systematic review databases (the Cochrane Database of Systematic Reviews (CDSR) and the Database of Abstracts and Reviews (DARE) had not covered literature relevant to this thesis.

Because of the breadth of topics covered in this thesis, and the large amount of literature published in some areas, it was not practical to do or present an exhaustive review of each area. However, I believe that the literature searches were sufficiently thorough, and it is unlikely that important information has been missed.

2.1 Neuropsychiatric disorders and exposure to organophosphate insecticides.

2.1.1 Introduction

One hazard in agricultural work is from the use of pesticides. In recent years in the UK there has been particular concern about the possible adverse effects of organophosphate (OP) insecticides in agriculture.

OPs are a group of chemical compounds that have been widely used as insecticides. In the UK, OP insecticides have been used in agriculture and horticulture, in veterinary practice, particularly in sheep dip to prevent and treat sheep scab, ticks and blow fly strike, and in various public hygiene products for use both by professional operators and the general public. One product (malathion) has been marketed for use on humans as a treatment for head lice.

OP compounds suitable for use as insecticides were developed during the 1950s and 60s and their use in agriculture increased rapidly during the 1970s since when levels of use have plateaued then declined.[18] In the UK the highest occupational exposure of humans to OP insecticides is from crop spraying (including in glasshouses) and sheep dipping. It was compulsory to dip sheep twice per year during the period 1984-1988, and then once per year up to July 1991, since when compulsory dipping has been discontinued.

Exposure may occur in a number of ways. In sheep dipping, highest exposures are associated with handling and mixing the concentrated products. Exposure to diluted insecticide may occur while dipping sheep or handling them after they have been dipped. Similarly with crop spraying, exposure may occur while mixing concentrate or loading the sprayer, while applying the spray or from contact with treated crops. Occupational exposure occurs mainly through the dermal route and by inhalation.

Dermal absorption is thought to be more important particularly in concentrate handling.

The level of occupational exposure is likely to be lower now than in the past. Steps have been taken, particularly since 1991, to increase awareness of potential hazards involved in the use of sheep dip and to provide more advice on safe handling and disposal.

The Pesticide Safety Directorate (PSD) approves the ingredients of agricultural insecticide products. Approved pesticides are also subject to review. Over the years risk assessments have become more detailed and increasingly precautionary. This has led to tighter restrictions and loss of some products from the market.

Under the Control of Pesticide Regulations 1986 (amended 1997) all pesticides must gain approval before their advertisement, sale, supply, storage or use is permitted in Great Britain. Anyone who sells, supplies, stores or uses pesticides must comply with the Regulations and employers have the responsibility to ensure that employees who may be required to use pesticides are provided with adequate instruction, training and guidance.

Only dippers holding a Certificate of Competence have been able to purchase OP sheep dip since 1995. In 1998 this restriction was extended to all sheep dips. Advice on safe handling of sheep dip has been produced and distributed by the Health and Safety Executive (HSE)[19] and Veterinary Medicines Directorate (VMD). The HSE leaflet includes advice on training, facilities and personal protective equipment (PPE). Similar information leaflets are available in Northern Ireland and a recent survey there found that 73% of people who had worked with sheep dip in the previous three years had read the advice book on safety. While most of these individuals wore Wellington boots and waterproof trousers, only half wore rubber gloves and 27% reported wearing a face shield while dipping sheep. Professional advice had been received on one fifth of farms using sheep dip.[20] Recent studies in England suggest that many dippers still do not wear adequate protective clothing.[21] In a randomised controlled intervention study, a three hour education session given to Wisconsin dairy farmers found a significant increase in the use of gloves and gear during the most recent application, at six-month follow up, and a reduction in the total number of pesticides used. But the intervention did not increase full PPE compliance or reduce reported dermal exposure. The authors concluded that more intensive educational programmes could improve this.[22] Even if appropriate clothes were worn, changing from work clothes in the home or bringing clothes and shoes inside has been identified as a factor that could increase pesticide exposure in the home.[23] In Indonesian farmers knowledge concerning dangers of pesticides was not sufficient to change their behaviours. Their overriding concern was crop damage and economic loss. [24] In a telephone survey of just under 2000 Californian farmers, it was found that they were more likely to use protective equipment for pesticides compared to other hazards such as dust and noise. Over half the farmers who worked with pesticides in the previous year used at least three types of protection for more than half the time, whereas for noise and dust under one third used reasonable protection for half the time or more. [25] It is not known how far these attitudes and practices extend to British farmers.

2.1.2 Clinical Effects

Acute and subacute effects

OPs are known to be acutely toxic and the short-term effects of OP poisoning are well established. Most of the acute ill health effects have been attributed to acetylcholinesterase inhibition with consequent accumulation of acetylcholine at synapses in the central, autonomic and peripheral nervous system. The clinical features include anxiety, restlessness, headache, respiratory depression, excess salivation, sweating, hypertension and muscle fasciculation followed by weakness and paralysis.

More recently an "intermediate syndrome" has been recognised. This may occur in approximately 20% of patients [26] one to four days after an acute OP poisoning incident. It is characterised by weakness of limb, neck and respiratory muscles, possibly arising from muscle necrosis, and lasts five to eighteen days. The exact pathogenesis of this syndrome is unknown at present, but there is probably altered function and activity of nicotinic receptors at neuromuscular junctions [26].

Acute poisoning with some types of OPs (but not those approved for use in the UK) may also result in a delayed polyneuropathy beginning one to four weeks after the event. This organophosphate-induced delayed neuropathy (OPIDN) is sensorimotor in type and predominantly affects the lower limbs, combined with varying degrees of ataxia.[18] OPs able to induce this effect can inhibit and age an enzyme in nerve cells called neuropathy target esterase (NTE), though the precise biochemical abnormality responsible for symptoms is still being investigated[27-30].

It is becoming apparent that, although inhibition of cholinesterases plays a key role in the toxicology of OPs, individual susceptibility, the inhibition of other enzyme systems and the direct effects of OPs on tissues are also important [26].

Chronic effects

Evidence for longer-term effects is less clear-cut. On the basis of clinical case reports and case series, various neuropsychiatric effects following episodes of acute poisoning or chronic low level exposure to OP insecticides have been postulated. Reported neuropsychiatric symptoms include sleep disorders, fatigue, headache, depression, impaired concentration, memory loss, muscle pains and spasms, numbness of the extremities and intolerance to alcohol. Other symptoms including nausea and respiratory complaints have also been recorded.[18] In the main, epidemiological studies have sought to measure peripheral neuropathy and cognitive function.

The term chronic OP induced neuropsychiatric disorder (COPIND) has been used by Jamal to describe chronic neurological/neurobehavioural damage, either following acute poisoning episode(s) ('COPIND phenomenon 1') or following long-term low level exposure ('COPIND phenomenon 2'). The mechanism by which the hypothesised damage is produced is not known, but is not related to acetylcholinesterase or NTE inhibition.[31] There is no distinction in the literature between the chronic effects from different types of OP insecticide or suggestion that OPs differ in their ability to produce COPIND (if the syndrome exists). The exact profile of the syndrome proposed by Jamal is not clear but is said to include persistent impairment of a wide range of mental abilities and of peripheral nerve function.[31]

Based on case studies of people referred with psychiatric problems following chronic low level exposure, a more precise description of a syndrome 'COPIND' has been proposed by Ahmed and Davies.[32] They suggest that a diagnosis of COPIND is made if 7 or more of the 10 symptoms given in the box below are present (Figure 2.1).

Figure 2.1 Symptoms of COPIND[32]

i)	severe incapacitating episodes of dippers flu (see text below)
ii)	personality change with mood destabilisation
iii)	impulsive suicidal thinking
iv)	memory and attention impairment
v)	language disorder
vi)	alcohol intolerance
vii)	heightened olfactory acuity
viii)	extreme sensitivity to organophosphates
ix)	handwriting deterioration
x)	inability to sustain muscular activity

They report two further studies to support their proposal.[33] In the first, a cross-sectional survey, a questionnaire was sent out to 400 farmers in Devon who were identified from Yellow Pages. It asked about exposure to organophosphates and specific symptoms. The response rate was 44% and a significant difference in the number of symptoms reported between exposed and non-exposed respondents was found. In the second study a questionnaire was sent to people who had registered their concern about ill health in relation to OP exposure. In this series of patients significant similarities in symptom profiles were reported. According to Davies' studies 5.3% of the population mailed in the first study and 16.2% of those exposed in the second study had COPIND. The latter study does not indicate if symptoms cluster abnormally or occur in excess in populations exposed to OPs. The questionnaires focused closely on OP exposure and specific symptoms, so increasing the possibility of recall bias.

One component of the proposed chronic syndrome is "dippers flu".[33] This is a term that has been used in the farming community since 1990s to describe flu-like symptoms, including runny nose, headache, aching limbs and malaise, that occur shortly after dipping and persist for up to 48 hours. It is not clear whether or not this is a manifestation of OP toxicity or relates to other toxins in sheep dip.[18]

At present there is insufficient evidence from other epidemiological studies to support the view that this chronic syndrome exists, particularly following chronic low dose exposure.[18] In order to establish if there are effects, epidemiological studies need to demonstrate that symptoms occur in a specific pattern, more than expected by chance, in people who are exposed. Also evidence for pathological mechanisms is needed if a medical model is to explain the symptoms.

Chronic fatigue has also been found to be common amongst those who consider their health to be affected by pesticides, however there is very limited evidence of an association between exposure to OPs and chronic fatigue.[34]

There is a school of thought that illness reported by farmers and attributed to OPs can be predicted by a 'biopsychosocial' model, i.e. a combination of personal, social, environmental and economic factors, rather than any specific pathological mechanism.[35] This view may help in planning individual treatment approaches but is challenging to investigate in a population.

2.1.3 Evidence from epidemiological studies on chronic effects of OP pesticide exposure

Few people consult medical services for alleged OP pesticide poisoning. On the premise that minor symptoms or sub-clinical abnormalities may occur more commonly in exposed populations than medical consultation suggests, and frequently enough to be detected in epidemiological studies, many researchers have compared the results of neuropsychological or other tests in people who have been exposed to OPs with those in unexposed controls.

Studies on the possible long-term effects of OP poisoning published prior to 2000 were reviewed and critiqued by a Department of Health Working Group on Organophosphates.[18] A summary of their conclusions relating to five groups of neurological outcomes following either acute OP poisoning or chronic-low dose exposure is given in table 2.1.

Table 2.1 ***Health Outcomes relating to the nervous system; a summary of conclusions reported by a Department of Health Working Group on Organophosphates.***[18]

Health Outcome	Main Conclusions from review of studies	
	Following acute OP poisoning	**Chronic low dose exposure**
Neuropsychological abnormalities	Cognitive impairment can occur No long-term memory loss	Balance of evidence does not support the existence of clinically significant effects
Electroencephalographic (EEG) abnormalities	Changes detectable, but effect on function unclear	No studies
Peripheral neuropathy and neuromuscular dysfunction*	Occasional persistent peripheral neuropathy but not usually symptomatic	Balance of evidence suggests no effect
Psychiatric illness	Limited evidence does not allow firm conclusions to be drawn	Not a major factor in suicide. Otherwise evidence is insufficient to allow useful conclusions.
Effects on the autonomic nervous system	Further studies required	Further studies required

**from OP pesticides that are non-inhibitors of NTE*

Studies on the long-term effect of acute poisoning may be useful in suggesting health outcomes that might arise from chronic low dose exposure. While high dose acute exposure is not equivalent to low dose long-term exposure, similar long-term health effects may occur. An absence of adverse effects following high dose exposure makes it less likely, though not impossible, that chronic low level exposure may have adverse health effects.[18] However it is plausible that cumulative effects could occur after prolonged low level exposure.

Six studies have looked for late sequelae of acute poisoning episodes.[36-41] The results of these studies (on neuropsychological abnormalities) are not entirely consistent. Having considered their strengths and weaknesses the Working Group on Organophosphates interpreted the studies as providing reasonable, although not conclusive evidence that OP poisoning of sufficient severity to require hospital admission can lead to persistent cognitive impairment, most evident in tests involving sustained attention and speeded, flexible cognitive processing. Long-term memory does not appear to be affected.[18] In a more recent cross-sectional survey of farmers and spouses in Colorado, those exposed to OP insecticides at a high enough concentration to cause poisoning were more than five times as likely to subsequently suffer from depressive symptoms than unexposed farm residents. However, the small number of pesticide illnesses reported in the study and an overall response rate of 55%, indicate that more work is still needed to determine if there is a causal relationship between depression and OP insecticide exposure.[42]

Therefore while there is accumulating evidence that there may be some long-term health effects, particularly cognitive impairment, following acute poisoning, there are still some uncertainties because of the quality of the studies. Furthermore, while studies indicate that some people do develop long-term effects after acute poisoning by OPs, the mechanism and clinical relevance remain unresolved.[43]

The Working Group reviewed a further 24 studies on subjects exposed or potentially exposed to OP pesticides, but with no reported history of acute poisoning. These included two retrospective studies investigating the link between suicide and pesticide exposure, in which no association was demonstrated.[44, 45] Also recent studies by the Institute of Occupational Medicine (IOM), that focused specifically on sheep farmers in the UK, were considered in detail.[46-49] While the results of these studies did indicate an excess of neuropsychological abnormalities in farmers exposed to OP sheep dips, there were inconsistencies in the findings and the Working Group did not consider them to be definitive. In common with other studies based on cross-sectional samples of working farmers, the IOM investigation was not designed to evaluate severe health effects that would prevent people working.

The review concluded that the balance of evidence did not support significant health effects of long-term low dose exposure, and that if effects did occur they must be rare.

One study on UK sheep dippers published since 1999 has considered similar neurological outcomes and raised a question about the reproducibility of sensory testing in the field,[50, 51] (discussed below under outcome measures). There have been few other relevant studies published since the review and none to alter the conclusions made. In Sri-Lanka, persistent sensory deficits were sought in 30 pesticide sprayers and 30 fishermen. Reduced sensory (but not motor) conduction velocity was seen during the cultivation season in both farmers and controls. This was attributed to environmental exposure in non-farmers. There was no evidence of a persistent effect as sensory conduction velocity returned to normal between cultivation seasons.[52] A cross sectional survey of farmers and their spouses in Colorado gives further support to the possibility of long term effects after acute poisoning. In this study several neurological symptoms were found to be significantly associated with reported pesticide illness including difficulty concentrating or remembering, feeling irritable or depressed, or having headaches at least once per week. Independent risk factors for pesticide related illness in this population were male gender, being depressed, sleeping too much and using an OP pesticide on the farm. As with other cross sectional studies the time sequence of exposure and outcome is not easy to determine in this study.[53]

One reason for the uncertainty about long-term effects of low dose exposure to OP insecticides is the difficulty in conducting satisfactory studies.

2.1.4 Study design and weaknesses

Weaknesses in studies may relate to how subjects are selected, or the ways in which exposure and outcomes are measured.

Subjects studied

People who are likely to have been exposed to OP pesticides, other than those who have suffered an acute poisoning episode, have been identified mainly because of their job. Groups studied include pesticide applicators,[54-56] orchard sprayers,[57-59] sheep dippers,[33, 38, 47, 48, 60] and less specifically, fruit farmers,[61] farmers[33, 62] or rural populations (in Equador).[63] Manufacturers of pesticides have also been investigated.[64-66]

Many of the studies have been small cross-sectional surveys of subjects exposed through crop spraying in non-European countries.[18] The small size of many of the studies suggests that significant health effects could go undetected. There have been relatively few studies concerned with sheep farmers in England.[33, 38, 47, 48, 60]

On the whole only current workers have been investigated, though one Californian study followed up 45 workers who had been removed from exposure to OPs because of low acetycholinesterase activity.[67] Therefore in most studies, workers who are too ill to remain in employment, possibly because of pesticide related symptoms, have not been included.

Exposure measures

Ascertainment of low- level exposure and its quantification is difficult, and in most studies non-specific or surrogate measures of exposure have been used. Few studies provide information on specific pesticides used.

Surrogate measures include job[65] or tasks undertaken.[60] Use of a combination of variables such as main task/job, size of flock, concentrate handling and money spent on pesticides, is thought to be a useful way of assessing pesticide exposure in sheep farmers.[38, 47] Recent studies have shown that in sheep farmers the majority of uptake of pesticide was due to handling the concentrate, rather than from being splashed by the dipwash itself.[49, 68] Direct questioning on amount and type of pesticide used may be prone to recall bias particularly where there is overt concern about health effects of OP pesticides.

In some studies of low–dose exposure, differences between exposed and control subjects other than their contact with OPs have been inadequately documented and controlled for and might have spuriously influenced their performance on tests.[38, 40, 41, 55] A number of studies of chronic-low dose poisoning have not specifically sought to exclude past acute poisoning.[18, 38, 41, 55, 60] This may contribute to inconsistent results.

Some small studies have used biomarkers, usually as a non-specific indicator of exposure. Only one study of this nature, reviewed by the Working Group on OPs, ascertained specific pesticides used.[56] Several studies have used erythrocyte or plasma cholinesterase as indicators of toxicity or exposure:[56, 58, 66, 67, 69, 70] lower cholinesterase levels on average would be expected in an exposed group, though the measures are not particularly sensitive or specific. There is considerable individual variation. Causes of decreased activity of cholinesterases include genetic constitution, age, gender, therapeutic agents, disease states, exposure to smoke fumes and dietary factors[26]. Also, clinical effects may be detectable in the absence of differences between exposed and non-exposed groups.[58, 69] For example, a recent study in Kenyan agricultural workers used 'blood acetylcholinesterase' activity as marker of degree of exposure in individuals. The study found an increased symptom prevalence (mainly respiratory and eye symptoms) at acetylcholinesterase levels not considered adverse.[71] Other researchers have measured urinary excretion of pesticide metabolites as a measure of exposure.[55, 60, 72] Peak excretion might be reached at different times after exposure depending on absorption route, metabolism and type of compound. Studies comparing urinary excretion of OP metabolites with inhibition of red blood cell acetylycholinesterase activity found no correlation between the measures. This had been attributed to low levels of OP metabolites in the urine from most workers which were unlikely to cause a significant reduction in blood cholinesterase activity.[26]

Outcome measures

Several methods have been used to assess health outcome in studies looking at the long-term consequences of acute poisoning and at the effects of chronic low dose exposure. They include symptoms on questionnaire,[55, 58] clinical examination,[47, 58] electromyogram (EMG),[69] neuro-physiological tests,[47, 56] neuropsychological (cognitive) tests[38, 41, 47] and electroencephalogram (EEG). Suicide is another outcome that has been considered in retrospective studies of farmers and in relation to their use of OP pesticides.[44, 45]

Most tests to assess cognitive function following acute poisoning have produced inconsistent findings[36, 38, 39, 41, 61] though this may be due to differences in severity of poisoning, rather than the tests themselves.[18] The most consistent findings have been found with simple reaction time and the digit symbol substitution test. The latter places the individual under time pressure and depends on multiple cognitive functions. It is questionable how valid some of these outcome measures are. For example subjective or semi-subjective measures such as symptom reporting and speed of completing an intellectual task are prone to observer bias if the researcher is aware of exposure status and recall bias may affect symptom reporting by subjects. Inadequate control for pre-existing ability, as determined, for example by IQ, education and motivation, may also influence results.

A quantitative measure used to diagnose peripheral neuropathy, quantitative sensory testing (QST), was developed for use in a clinical setting. It has been found to be of limited reproducibility in the field,[51, 73] yet this test, along with others, has been quite widely used.[50] EEG abnormalities following acute poisoning have been sought in two studies.[40, 74] While this measure is less subjective than some other tests, its clinical relevance is less clear.

Another weakness applicable to many studies is the potential for response bias, because those who have symptoms and a history of exposure are more likely to participate.

2.1.5 Conclusion

OPs are acutely toxic and the balance of evidence suggests that there are long-term effects following acute poisoning. There are also concerns about disabling neuro-psychiatric disease from low dose exposure without overt acute toxicity, but currently available evidence does not indicate that this leads to symptoms. There may be individuals who are unusually susceptible but studies have lacked power to identify them. It is also controversial whether or not there is an identifiable syndrome in the form proposed by Ahmed and Davies.

There is a need for further research. As identified by the Working Group on OPs [18] the possibility remains that a small minority of individuals may be particularly susceptible to the effects of OPs. In support of this, a recent case-referent study found that polymorphisms in human serum paroxonase (PON1) gene, and associated reduced activity of the enzyme, were associated with chronic illness that subjects attributed to OPs. PON1 hydrolyses diazinonoxon, the active metabolite of diazinon, which is an OP used in sheep dip.[75] This may indicate a pathological mechanism by which only certain individuals are susceptible to long-term symptoms. On the other hand it is perhaps more likely that reduced enzyme activity leads to an increased susceptibility to acute poisoning and the resulting increased awareness of potential toxicity of OPs is a factor in developing long-term illness. The biopsychosocial model (i.e illness resulting from a complex interaction of physical, psychological and social processes) may be an alternative explanation as to why only a subgroup of those exposed become ill,[35] if indeed they do.

To address whether there are certain individuals who are susceptible, and become symptomatic is not easy. By focussing on currently employed occupational groups, those too ill to work are selected out. A large community survey should enable identification of such a group if they exist. A study of this sort could also be used to investigate further the nature of dippers flu.

2.2 Health effects associated with other pesticides and chemicals

A range of other compounds are commonly used in agriculture. These include herbicides, fungicides, chemical fertilizers, wood preservatives and disinfectants, as well as insecticides containing chemicals other than organophosphates.

Data on the magnitude of health problems associated with occupational use of these substances is limited. It is problematic addressing long-term and non-specific effects, but there is information concerning acute effects, some from reported incidents. With regard to pesticides, the HSE's Pesticide Incidents Appraisal Panel (PIAP) investigates complaints and alleged ill-health incidents. From 1995/96 until 2000/01 an average of 81 alleged ill-health incidents involving pesticides were investigated each year. Most complaints were from members of the public, but at least some public complaints were a result of farmers spraying crops in inappropriate conditions.[76] It is likely that many more minor incidents go unreported and fail to appear in official statistics. In a survey of farmers in south-west Hampshire, of 84 pesticide users, 15% said they had had an accident or health problem involving the use of an agricultural chemical.[77] Medical attention may not be sought for many incidents. An analysis of all admissions to the Regional Poisoning Treatment Centre at the Royal Infirmary in Edinburgh over the period 1981 to 1986 identified ten admissions following work related exposure to pesticides (an average of only one to two per year).[78]

The health effects investigated by the PIAP have usually been short lived and minor. In the two years 1999/2000 and 2000/01, 70% of those reporting ill-health were assessed as having mild symptoms, 23% moderate and 7% severe symptoms. No-one appeared to suffer chronic ill health as a result of a reported incident[76]. The nature of symptoms depends on the type of chemical, dose and route of exposure. Skin, eye and throat irritation are among the effects reported following aerosol exposure to herbicides and to sulphuric acid, used to desiccate potato haulms[76]. Skin contact with a variety of chemical substances, including pesticides, has been associated with contact dermatitis, (see section 2.9.2), and disinfectants are one group of chemicals that have been associated with respiratory symptoms.[79] Of the fifty-seven admissions to the Edinburgh Royal Infirmary for pesticide poisoning from 1981 to 1986, most patients had no symptoms or relatively minor and short-lived ones such as nausea, vomiting, abdominal pain, diarrhoea, coughing and breathlessness. Only one life-threatening illness, and no deaths, resulted from work related accidents. Deaths did occur from non-work related exposure, due to suicide and/or intake of the herbicide paraquat.[78] Analyses of deaths from pesticide poisoning in England and Wales from 1945 to 1991 support the Edinburgh findings. Deaths from pesticide poisoning accounted for a small proportion (about 1%) of deaths due to poisoning. Almost three quarters of the deaths were suicide and the most common cause of fatal poisoning was paraquat.[80, 81]

Many incidents investigated by PIAP arose because of poor practice such as spraying crops in windy conditions.[76] Case reports of incidents suggest that many incidents could be prevented if safer working practices, according to existing recommendations, had been adopted.[76] At least half of the work related accidents admitted in Edinburgh were thought to be preventable with adequate training, as they arose from lack of common sense, failure to comply with safety regulations or from failure to maintain spray equipment.[78] Farmers' attitudes and behaviour regarding safety precautions when handling chemicals often fell short of that which is recommended.[77]

There is limited information on the frequency of incidents involving exposure to substances containing pesticides and resulting degree of morbidity. It is likely that adverse effects are more common than suggested by official complaints or admissions to hospital. Many incidents may be preventable if individuals take appropriate safety precautions. In order to justify commitment of resources to interventions that may influence attitudes towards safety, more information on ill-health resulting from compounds used in agriculture is required.

2.3 Mental health

As discussed in section 2.1 it has been postulated that OP insecticide exposure affects the mental health of farmers. But there are other factors that may be important. For example running an agricultural business is potentially stressful and it is likely that recent farming crises have made it more so.

2.3.1 Prevalence of depression and other mental disorders

It is unclear whether the mental health of farmers is worse than in the population as a whole but farmers in England and Wales have an elevated risk of suicide compared to the rest of the population.[67] The proportional mortality ratio (PMR) for deaths caused by suicide in male farmers calculated from data for the period 1979-1990, was 156 and 187 in two separate studies.[82, 83] Numerically these deaths are significant and are said to account for 1% of suicides, in the 16 to 64 age group, in England and Wales[13, 67, 84] and an even higher proportion in rural areas. In an analysis of suicides in North and West Devon, over the 3 years, 1988-1990, farmers and their wives accounted for 12% of the deaths attributed to suicide.[353] This figure appears to be only partly explained by the proportion of farmers. According to 1991 census data the proportion of economically active men who were farmers in North and West Devon was a little below three times the proportion in England and Wales (7-9% compared to 3%). Compared to other occupations, farmers have the oldest age distribution for suicide with just under a third in the 16-44 age group and a quarter in men aged 65-74 years.[84]

Mental illness is one risk factor for suicide. Of 84 suicides investigated by Hawton et al[45] only one fifth did not have prior evidence of a mental disorder. Most of the psychiatric diagnoses were depressive disorders. Anecdotal evidence suggests that farmers are under a lot of stress, but there is limited objective evidence on the state of their mental health or the prevalence of depression.

A postal survey of 203 male and female farmers in Northumberland found that 37% were depressed, based on a score on the Hospital Anxiety Depression (HAD) Scale of 8 or more and 12% severely depressed, scoring 11-21.[86] There is little comparative data for the general population, but in a sample of over 21,000 patients, 16 years old or over, attending general practices in Hampshire, 20% scored 8 or more, on the HAD scale.[87] In a sample of general practice managers in south-east England 17% were depressed using the same criteria.[88] Therefore based on these studies it does appear that depression is more prevalent in a farming community (in the north of England), than in the general population in the south of England. Norwegian farmers (aged 40 – 49 years) were also found to have higher levels of anxiety and depression than non-farmers when mean scores on the HAD Scale were compared in a population based study of 17 295 male and female workers. The sample included 917 farmers.[89]

A study of mortality from major causes of death in farmers aged 20-74 years in England and Wales, during 1979-80 and 1982-90 did not suggest a significant increase in death due to mental disorders: PMR 103 (95% CI 91-115) in male farmers and 127 (95% CI 81-189) in female farmers and 92 (95% CI 80-105) in farmers' wives. However the range of diagnoses included under mental disorder (ICD-9 codes 290-319 include affective psychoses, neurotic disorder, schizophrenia, paranoid states and alcohol and drug dependence) may mask specific problems. Also mortality is a poor marker for incidence risk of these diseases.

Using different criteria to identify psychiatric morbidity, the Revised Clinical Interview Schedule (CIS-R), 425 farmers in Hereford, Norwich and Preston were interviewed in 1999, and compared to the general population using data from the OPCS 1993 National Psychiatric Morbidity Surveys of Great Britain. Farmers had a lower prevalence of psychiatric morbidity than the general population. Clinically relevant psychiatric morbidity was found in 6% of farmers. However they were more likely to report thinking that life was not worth living. When compared to rural or semi-rural householders, after taking into account the low prevalence of psychiatric morbidity the odds ratio for farmers thinking that life was not worth living was 3.26 (95% CI 1.51 – 7.02).[90]

A national co-morbidity survey in the USA, also found the prevalence of depression (DSM – III- R major depressive episodes) in a farming population to be lower than in the general population, less than half the rate in males.[91] It has been proposed that the differences observed may be related to the healthy worker effect (i.e. those currently in work are likely to have better health than the general population as this includes people who do not work because of ill health).[42] Other factors that may contribute to a high suicide rate are discussed in Section 2.3.2.

In summary, farmers have a high suicide rate compared to the general population, but the relative prevalence of clinical depression is not clear owing to inconsistencies in study findings. A survey of farmers, prior to the 2001 foot and mouth outbreak, which compared psychiatric morbidity to that of the general population found such morbidity to be relatively low in farmers but they were significantly more likely to report thinking that life was not worth living.[90]

2.3.2 Factors contributing to stress in farmers

Various occupational factors may affect the mental health of farmers, including financial difficulties, social isolation and physical ill health. Access to effective means of suicide also influences suicide rates.

Financial and management issues

Financial worries and management of a business may cause stress, particularly among self-employed farmers.

Simkin et al[14] sent a postal questionnaire to 1000 randomly selected members of the National Farmers Union (NFU) or the Farmers Union of Wales to investigate potential sources of stress. Half were returned completed between October 1995 and March 1996. Of those who answered, 62% of farmers reported problems with record keeping and paperwork, 56% difficulty understanding forms, and 49% had problems arising from the effects of new legislation and regulations. 23% reported financial problems and 79% worry about money. It is not clear if these rates of self-expressed worries are higher than in the general or self-employed population. But, in an analysis of suicide victims, financial difficulties in farmers who either had or had not committed suicide, did not appear to differ.[45] In a survey of farmers in Hereford, Norwich and Preston, unemployment or describing their financial situation as difficult seemed to be associated with greater psychiatric morbidity but the associations were not statistically significant.[90]

There have been additional stresses in recent years in the UK. According to the NFU, a period of economic depression in agriculture began in 1996 and affects every sector of the industry. Factors responsible include the high value of the pound against the euro, which encourages food imports and reduces exports; and the foot and mouth crisis in 2001. Other factors contributing to falling incomes have included indirect taxation, e.g. fuel costs, and a collapse of world commodity prices meaning that British farmers get paid less for what they produce. There have also been significant losses to crops and farm buildings in recent years because of flooding.[4]

The impact of these pressures on the mental health of farmers has not been clearly quantified.

Recent pressures, in particular foot and mouth disease, have undoubtedly affected the rural economy resulting in collapse of some industries and job losses, though for agricultural businesses, at least there is support in the form of financial help and advice on rebuilding the business. While the potential psychological effects of the recent outbreak have been recognised, there is little other than anecdotal evidence on the overall health impact.

The common perception that the mental health of farmers has suffered as a result of the 1996 'beef crisis' has not been convincingly demonstrated in epidemiological studies. A study on approximately 200 subjects from one semi-rural practice in North Yorkshire found that between two surveys in 1994 and 1996, farmers (a mix of arable, beef and dairy farmers) remained more anxious and depressed than controls (age matched males in other employment). However anxiety and depression measured by the Hospital Anxiety Depression (HAD) scale decreased in both farmers and controls, though significantly more in the control group.[92] Therefore short-term effects on mental health are unclear and the long-term effect of BSE on the mental health of farmers remains unknown.

Some work on the short-term impact of the foot and mouth outbreak in 2001 has been done on people in Wales. People working in advice agencies, health services and farming related agencies were interviewed in April and May 2001 concerning help sought relating to the foot and mouth crisis. For non-farming businesses the main source of stress and seeking advice was financial. For farmers and their families there were many sources of stress including uncertainty over the short and long- term future, financial, the bereavement of losing their stock and concern over the welfare of existing stock. Only four GPs were interviewed in the survey and they reported seeing patients with stress anxiety and depression. One put 50% of these patients on antidepressants, though another prescribed less and spent time supporting families in other ways.[93]

There have been some studies in the US following a farm crisis in the 1980s. Community breakdown, loss of family farms, family disruptions, individual despair and even suicide were among the human consequences noted by a number of researchers.[94] Similar effects are reported in the UK but as discussed above, there have been few quantative or long-term studies.

Social isolation and help-seeking behaviour

One factor in suicide prevention is to provide social support for those at risk. Hawton et al. found that, compared to other farmers, farmers who had committed suicide were significantly more likely to have lived alone, and less likely to have close friends or anyone they would normally confide in.[45] A Northumberland survey of self-rated depression and anxiety also found that being married or having a confidant at home was relatively protective for men.[86] However most farmers do not appear to be socially isolated. Simpkin's survey of UK farmers found that over 90% of respondents had at least one confidant.[14]

Farmers do appear to seek medical help. Hawton found that compared to a control group of farmers, those that had committed suicide were more likely to have visited their GP in the previous 3 months or 3 months before death.[45] But there may be some differences in help-seeking behaviour between farmers and the general population. In a retrospective case-control study male farmers on whom suicide or open verdict had been recorded (between 1979 and 1994) were compared with an age and sex matched control group who died similarly, within the same Health District (Exeter). There was no significant difference between farmers and controls for numbers in contact with their general practitioner or mental health services in the 3 months before death, although over 30% of farmers presented with exclusively physical symptoms.[13]

Therefore social isolation and lack of health seeking behaviour may be of importance in suicide but most farmers are not socially isolated.

Type of farming and other work pressures

In a retrospective review of psychosocial histories of a sample of farmers in England and Wales, who had committed suicide between October 1991 and December 1993, ("a psychological autopsy study") two thirds had problems connected with work at the time of death. These included financial problems in 26%.[45]

In a survey of farmers in England and Wales, 70% worked more than 10 hours a day.[14] However, only 56% of the suicide victims in the psychological autopsy study worked more than a 10 hour day.[45] Long hours alone may not be a significant source of stress, but when combined with other factors such as mental or physical ill health or personal or occupational stress, pressure to continue working seven days a week may become more significant.

Physical ill health and ability to contribute to the farm are a particular issue in older men. In the psychological autopsy study, among retired farmers the majority (85%) were physically ill at the time of death. In some cases there was no evidence of accompanying depression or mental health problems.[45] There is an association between depressive symptoms and physical ill health, demonstrated in a number of studies, though it is often not clear which is the aetiological factor.[90, 95]

As discussed in section 2.1, there is concern, mainly among sheep farmers about effects of OP insecticides. In a survey of farmers in England and Wales 16% of the sheep farmers reported symptoms which they attributed to organophosphate poisoning[14]. Many symptoms reported were related to mental health, and a study from Colorado, published in 2002, suggests depressive symptoms may be more common after acute OP poisoning[42]. Two large studies reviewed by the Working Group on OPs did not suggest an association between probable pesticide use and suicide, but neither study had data on specific pesticides or exposure levels.[44, 45] According to the psychological autopsy study mentioned above[45] while most of the sheep farmers who had committed suicide had been exposed to OP sheep dips, the reported prevalence of symptoms attributable to OPs was similar to that in working farmers who were not suicide victims. Furthermore, the same study found that the proportion of sheep farmers among suicide victims was no different from the proportion among a control sample of farmers. However, pig farmers were significantly more common among suicide victims, but the numbers were small, so it is not clear if this group are particularly at risk. Otherwise there was no clear pattern according type of farming in this study; the numbers of livestock and arable farms in the suicide sample reflected a similar distribution to national figures.[45] Older age appeared to be an important factor, more so than for other occupations.[45]

A Canadian study found that the self-reported incidence of stress related symptoms was significantly higher in mixed grain and livestock operations as opposed to solely grain farming operations. These differences may reflect the fact that maintaining livestock in addition to grain farming introduces an additional set of occupational stressors: daily care of livestock, problems with disease, breeding or reproductive difficulties, increased difficulties in getting off for holidays, and the need to worry, evaluate, and predict an additional set of commodity price fluctuations.[65] These findings were supported in a Norwegian population based study, using the HAD Scale as a depression measure, in which male livestock farmers were found to have the highest depression levels among farmers. In this study, for full time farmers the higher depression levels compared to non-farmers could be explained by a combination of long hours, physical hard work and lower income, but for part-time farmers no model of combinations of work and/or lifestyle factors could be found to explain the higher depression levels [89]. The Canadian study found that self-reported symptom rates were significantly higher in farm women than farm men and higher in younger farmers. Off-farm employment was also associated with a higher incidence of self- reported symptoms. It was possible that these farmers sought additional employment because of greater economic distress. The extra demands of off-farm employment in addition to usual farm workload may have created additional pressures and ultimately produce higher symptom levels.[65]

Regional differences

There are regional differences in suicide rate. For example, high rates have been reported in Devon,[67] and among men in the Highlands of Scotland.[96] In a study of suicide in a rural district of Yorkshire, the suicide rate was not high but there was a trend suggesting higher rates in the more rural areas than the less rural areas. And more violent methods were used in the rural district compared to the general population.[97] It is not clear how regional differences relate to occupational patterns, but the high rate in several rural areas fits in with farmers being a high-risk group.[84] Local factors other than occupation may influence suicide rate, including geographical factors such as isolated moorland where cars can be parked, high bridges over roads and rivers, and the availability of guns in a predominantly rural community. Booth found that 42% of farmers used firearms to commit suicide compared to 11% of non-farmer age and sex matched controls from the same health district.[13] In that study hanging was the second most common means of suicide, but with stricter regulation of guns it has become more common than shooting.[82, 98]

Local coroners verdicts may be influenced by the way individuals kill themselves. It is known that there is an increased likelihood of coroners offering a verdict of suicide on deaths occurring in a violent manner, so this may also influence reported regional differences. So for example, a study of suicide in North and West Devon (1988-1990) found that residents were significantly more likely than those in the rest of

England and Wales, to choose a violent means of suicide e.g. death by firearms or explosives, by cutting or piercing instruments or by jumping from a high place. The proportionately high number of suicides for North Devon District Health Authority (as reflected by SMR) may reflect the non-equivocal way in which individuals kill themselves in North and West Devon. The significantly elevated SMR for suicide and self-inflicted injury (ICD-9 codes E950-959) in North Devon District Health Authority disappeared when the category of deaths caused by 'injury undetermined whether accidentally or purposefully inflicted' (ICD-9 codes E980-989) was included, for the period 1986-90. In this district, between 1984 and 1990 the ratio of suicide verdicts to open verdicts was greater than 7:1 compared to a ratio of under 2:1 for England and Wales.[85]

2.3.3 Conclusion

In a high proportion of individual cases of suicide among farmers, mental illness and access to violent means appear to be significant factors. It has been suggested that organophosphate exposure may contribute to a proportion of psychiatric disorders in farmers, but there are other factors such as financial pressures, type of farming and farming crises that also may be of importance. All have been considered as contributors to mental illness in different studies, but the importance of each is not yet clear. Studies in the US suggest farming crises may have a significant impact on anxiety and depression.[94] There is limited evidence from the UK to support this but as yet, there have been few studies

In order to target resources appropriately it would be useful to have clearer information on the prevalence of mental health problems in agricultural workers, particularly in areas that have suffered because of recent farming crises.

2.4 Accidents

2.4.1 Introduction

As outlined in chapter 1, work in agriculture is potentially hazardous. For example accidental injury may occur from use of machinery, farm vehicles, lifting or moving heavy loads, and working with animals. There is evidence that the frequency of accidents (both fatal and non-fatal) is relatively high in agricultural workers in the UK.[16] This information comes principally from reporting required under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). Under RIDDOR, accidents resulting in death, major injury or loss of more than three days from work must be reported to the Health and Safety Executive (HSE) or, in some cases, to local authorities.

2.4.2 Fatal Injuries : frequency & personal factors

Over the first 13 years that RIDDOR operated (1986/7 to 1998/9), 602 fatal injuries were recorded among agricultural workers in Britain, an average of approximately one per week.[99] This corresponds to a crude annual death rate of 8.8 per 100,000, a figure about five times as high as for all industries combined. Mortality from injuries at work was even higher in forestry than in other branches of agriculture, but this difference may have occurred by chance.[16]

Within the total of 602 fatal injuries, 340 deaths occurred in self-employed agricultural workers and 262 in employees. Table 2.2 gives a breakdown of the deaths among employees by age. Death rates were higher in workers 55 years and older. Assuming the observed differences were not due to chance, possible explanations for the excess include differences in risk-taking behaviour, increased susceptibility to accidents because of impaired senses and reaction times, and poorer survival when subjected to trauma.

Table 2.2 Fatal Injuries to employees in agriculture from 1986/87 to 1991/92 in Britain[99]

Age	Number of fatal injuries 1986/7 – 1991/2	Annual incidence rate /100,000 employees
16-19	32	10.1
20-24	33	7.8
25-34	46	6.4
35-44	39	7.1
45-54	35	7.3
55-64	40	11.2
65 and over	17	16.7
Age unknown	4	-
Total	246	

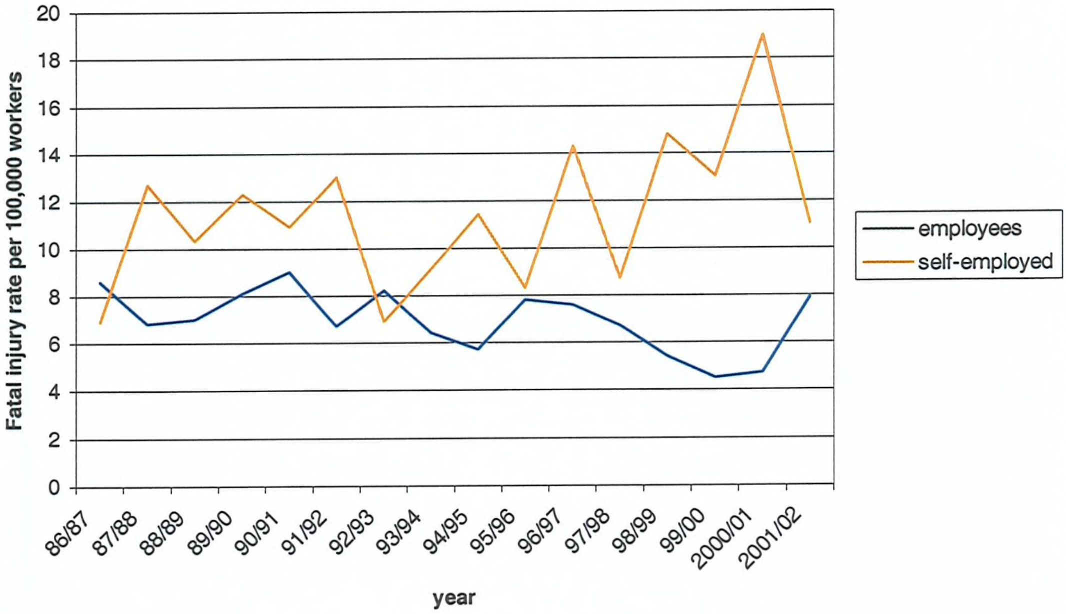
incidence rate for self-employed and calculated rate for more recent years not published

Age-specific rates of fatal injury are not available for self-employed agricultural workers, but the fatal injury rate for all ages was higher than that of employees for most years between 1986 and 2001 (Figure 2.2).[99, 100] This may reflect a confounding effect of age (self-employed farmers tend to be older), differences in the type of work undertaken or the hours that they work, use of older and less well designed equipment, or a greater propensity to take risks by those who are self-employed.

It is also apparent from Figure 2.2 that there has been no clear secular trend in fatal injuries among agricultural workers over the years that RIDDOR has been in operation.

It is unclear how death rates from injuries compare between the sexes. However, a proportional analysis of mortality in England and Wales based on information obtained from death certificates has suggested that most of the potentially fatal occupational hazards associated with farming extend to female farmers and farmers' wives.[83]

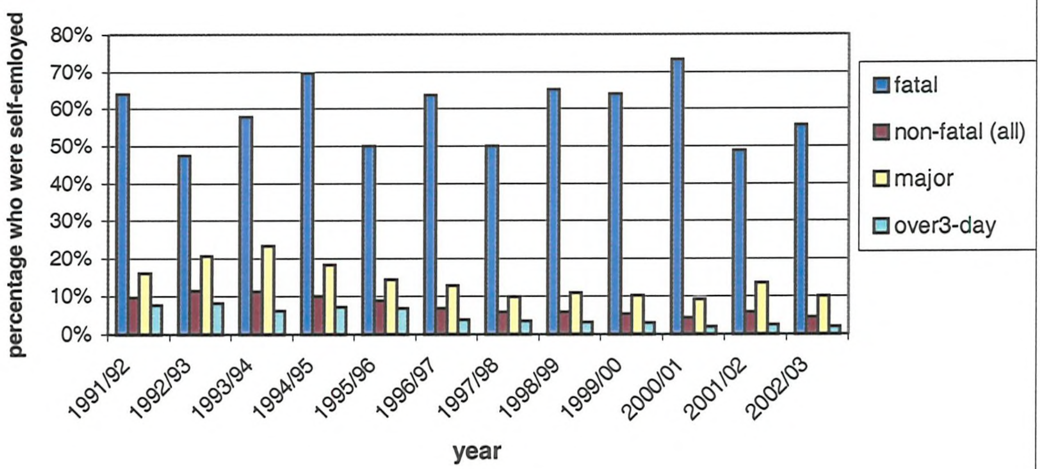
Figure 2.2 Fatal Injuries to Employees and Self-Employed People in Agriculture 1986/87 to 2001/02



2.4.3 Non-fatal injuries

The frequency of non-fatal injuries is much less clear because of incomplete reporting of injuries under RIDDOR. Under-reporting is thought to be greater among agricultural workers than most other occupational groups[16] and self-employed farmers are least likely to report injuries. Of the fatal injuries reported in agricultural workers (1992/93 to 2001/02), 59.4% were in self-employed farmers.[100] Yet of non-fatal injuries reported between 1986/87 and 2001/02, 8.7% (annual range 4.3% to 12.5%) were among self-employed with a lower proportion in recent years.[99, 100] Self-employed farmers were relatively more likely to suffer, or report, major injuries compared to over three-day injuries, but the proportion reported compared to agricultural employees was still low.[101] Figure 2.3 illustrates the proportion of injuries reported by self-employed workers for different categories of injuries since 1991/92. Among self-employed farmers, the completeness of reporting was estimated to be less than 5% in 1998/99.[102] However despite this, between 1986/7 and 1991/2, the reported rate of major injuries in agriculture was two to three times higher than that for all industries.[16]

Figure 2.3 Proportion of reported injuries in agricultural workers reported by self-employed individuals



Another source of data on work related injury is the Labour Force Survey (LFS), a cross-sectional survey of households. The starting sample of households is large, but when accidents are broken down by occupation and type, the numbers in each category are small, and confidence intervals around injury rates are wide. The accuracy of injury rates may also be impaired by errors in recall of accidents, which are ascertained for the previous 12 months.[17]

The estimated reported injury rate in agricultural workers, according to the LFS was 2270 per 100,000 during 1998/9. This is 3.6 times the rate based on RIDDOR statistics for the same year, (633 per 100,000). The actual injury rate may well be higher than either of these estimates: a prospective survey of patients attending the Accident and Emergency Department in Aberdeen has suggested that over the course of one year, almost one in 10 workers in the agricultural sector will attend casualty because of a work-related injury.[103] Some of these may have been more minor injuries than those reportable under RIDDOR however. In a survey of a 10% sample of family farm businesses in Northern Ireland, during 2001/2, under 2% of persons had had an accident requiring medical attention in the previous 12 months (slightly less than the LFS estimate for Great Britain) and these accidents had occurred on 3% of farms.[20]

The LFS data suggests that the rate of reportable injuries may be rising, with a 24% increase between 1997/8 and 1998/9. However, the estimated rates are based on small numbers of accidents so could be chance variation. RIDDOR statistics indicate a 5% fall over the same period.[17]

2.4.4 Types of accidents and related tasks

Fatal injuries

Table 2.3 shows the distribution of fatal accidents reported under RIDDOR between 1986/7 and 1998/9 according to their immediate cause.[99] In a more recent (but overlapping) summary of statistics for the years 1992/93 to 2001/02, the relative frequencies of types of accident are very similar.[100] Overall, the most frequent categories of fatal accident were those involving vehicles and machinery, and falls from a height. In addition, electrical injuries accounted for a relatively high proportion of deaths among employees, although not in self-employed farmers. This difference was largely attributable to electrocution by overhead power lines. Case reports of fatal injuries during 1999/2000 suggest that many of these accidents were caused by aluminium ladders used in fruit picking and forestry work coming into contact with overhead lines.[99]

With regard to the types of task carried out by agricultural workers, maintenance work (of land, machinery, buildings and trees and woodland) was associated with the largest number of fatalities in Britain over the 13 years up to 1998/9, (111 deaths, 18.4% of the total). Animal husbandry (housing and handling animals) accounted for 87 fatalities (14.5%); tractor driving 61 (10%); and storage of crops or processing of crops for storage 56 (9.3%).[99] However, without appropriate denominators, it is not possible to translate these figures into estimates of risk.

Table 2.3 Fatal injuries to employees and self-employed in agriculture, 1986/87 to 1998/99 in Britain, according to type of accident[99]

TYPE OF ACCIDENT	*Employees* (% of total)	Self-employed (% of total)	Total numbers (% of total)
Struck by a moving vehicle	49 (18.7%)	62 (18.2%)	111 (18.4%)
Falls from a height	39 (14.9%)	56 (16.5%)	95 (15.8%)
Trapped by something collapsing or overturning	29 (11.1%)	52 (15.3%)	81 (13.5%)
Contact with machinery or material being machined	37 (14.1%)	42 (12.4%)	79 (13.1%)
Struck by a moving, including flying or falling, object	28 (10.2%)	52 (15.3%)	80 (13.3%)
Contact with electricity or an electrical discharge	37 (14.1%)	16 (4.7%)	53 (8.8%)
Asphyxiation	19 (7.3%)	19 (5.6%)	38 (6.3%)
Injury by an animal	12 (4.6%)	23 (6.8%)	35 (5.8%)
Other	12 (4.6%)	18 (5.3%)	30 (5%)
TOTAL	262	340	602

In North Carolina farm traffic sharing public roads has been identified as a safety concern with various safety measures such as adequate lighting on vehicles, slow moving vehicle signs and warning signs for drivers.[104] It is not clear if accidents on public roads are a significant problem in the UK. Transport and associated accidents are the largest single cause of fatal injuries in the agricultural sector, the most common type of accidents being struck by or falling from a moving vehicle and being trapped or crushed when a vehicle overturns. However it appears that many of these accidents are caused by poor vehicle maintenance such as defective brakes and worn tyres and occur on farms. [83]

Non-fatal injuries

The main causes of non-fatal injuries recorded under RIDDOR during the 1996/7 to 2001/2 are presented in Table 2.4. It is notable that while manual handling injuries made up 22% of the total reported for employees, they accounted for just 6% of the non-fatal injuries among self-employed farmers. While this might result from differences in the work undertaken by employees, it seems more likely that it reflects a greater financial pressure on self-employed farmers with back and other musculoskeletal injuries to continue at work where possible (one of the criteria which renders accidents reportable under RIDDOR is absence from work for more than three days). The difference may also reflect a reporting bias among self-employed farmers. Information about the immediate causes of non-fatal injuries is not available from published analyses of the LFS, so that data cannot be compared.

Table 2.4 Non- fatal injuries to employees and self-employed people in agriculture for the year 1996/97 to 2001/02 in Britain [99, 100, 105-108]

TYPE OF ACCIDENT	Employees	Self-employed	Total
Handling, lifting or carrying	2651 (22.1%)	44 (6.1%)	2695 (21.2%)
Slip, trip or fall on the same level	2118 (17.6%)	71 (9.8%)	2189 (17.2%)
Struck by a moving including flying/falling object	1996 (16.6%)	150 (20.7%)	2146 (16.9%)
Falls from a height	1467 (12.2%)	128 (17.7%)	1595 (12.5%)
Contact with machinery	1059 (8.8%)	120 (16.6%)	1179 (9.3%)
Injured by an animal	823 (6.9%)	65 (9.0%)	888 (7.0%)
Strike against something fixed or stationary	552 (4.6%)	20 (2.8%)	572 (4.5%)
Struck by a moving vehicle	368 (3.1%)	42 (5.8%)	410 (3.2%)
Exposure to, or contact with, a harmful or hot substance	277 (2.3%)	15 (2.1%)	292 (2.3%)
Trapped by something collapsing or overturning	118 (1.0%)	25 (3.5%)	143 (1.1%)
Other kind of accident	577 (4.7%)	44 (6.1%)	621 (4.9%)
TOTAL	12006	724	12730

With regard to the types of task carried out by agricultural workers whose injuries were reported under RIDDOR during 1998/9, the general categories of 'transfer on site', 'loading and unloading', and 'handling' contributed almost 40% of the total. Maintenance activities accounted for 14.5% and animal husbandry 9%.[99]

Again, without appropriate denominators risk estimates cannot be calculated. Also, because of under-reporting, it is not known how well the types of injuries reported reflect the actual pattern of non-fatal injury.

A study of 112 farming accidents in mid-Wales reported that 65% of the accidents involved farm machinery, most commonly tractors and animals accounted for most of the rest. This study took place over a 12 month period in 1993/4. Data were collected by questionnaire on all farming related accidents and injuries which presented to the two primary health care teams in Montgomeryshire, with a combined population of 11000 patients. In this study falls accounted for 25.8% of accidents and foreign body/projectile accidents accounted for 21.4%. Lifting accidents only accounted for 2.7%.[109] Conversely, but in keeping with RIDDOR statistics, a Californian, population based, telephone survey found that overexertion accounted for 24% of farm work related injuries. The strain and sprain type injuries reported predominantly involved the back. This study also found that multiple injury events in the same individual occurred more frequently than by chance.[110]

Several studies have shown that among animal related injuries, the highest risk of injury was associated with tending cattle.[111-113] A cross-sectional survey of members of the NFU of Scotland with beef or dairy cattle, looked specifically at injuries occurring while tagging calves or clipping cattle.[114] Tagging or clipping related injuries in the previous 12 months were reported by 24% of respondents, and 23% reported sustaining other cattle handling injuries. Almost 25% had lost time off work as a result. Significant factors associated with tagging related injuries included not having a handling facility, tagging in an open field and working alone. These factors suggest that there is potential for reducing injury risk. The rational for clipping before slaughter has been to reduce microbial contamination of meat. The effectiveness of this is doubtful and the Food Standards Agency has now advised that clipping should be a last resort for removing visible dirt.

2.4.5 Personal behaviour and safety factors

In the study of farming accidents in mid-Wales, 71% of the accidents were deemed to be preventable with either more care or appropriate use of protective equipment and clothing. Protective clothing or equipment was only actually used in 6.3% of accident situations.[109]

Personal behaviour is likely to influence the risk of sustaining an injury but it is difficult to measure and thus to control for this. A number of studies, mainly in countries other than the UK, have looked at the influence of personal factors on the occurrence of accidental injuries in agriculture. A Canadian investigation found that risk-taking behaviour and a belief that accidents were inevitable increased the likelihood of injury, whereas the implementation of specific safe farming practices had the opposite effect.[115] The importance of attitudes to safety as a determinant of safety performance is further supported by a survey of Hampshire farmers in the UK,[77] and in an Irish population study.[116] In the Irish study farmers had a significantly lower perception of risk from hazards associated with manual handling and machinery, compared with the general workforce. Furthermore only 8% of farmers had participated in safety training compared to over 40% in both rural and urban workers.[116] In a survey of risk perception by farmers in England and Wales it was observed that recognition of hazards could be associated with less risk taking behaviour but did not necessarily lead to better risk management.[117] A Danish randomised controlled trial suggested that a combined programme of safety audit and safety behaviour training could substantially reduce the number of farm injuries.[118] Other factors have also been identified as influencing farm or machinery-related injury rate in Iowa farmers. These include work related factors such as long hours worked, large livestock and less farm experience, health factors such as wearing a hearing aid and taking regular medication, and personal and behavioural factors such as young age, higher education and high intake of alcohol.[119, 120] Good farm management may be another factor. In a Finnish study the size of farm did not appear to influence injury risk, but good working capacity did, i.e. no significant delays or complaints of exhaustion was associated with less injuries.[121] Also hurry, fatigue and stress had been reported as primary contributing factors to most injuries in an assessment of the Iowa Certified Farm Safe programme.[122] The biggest risk factor in the Finnish study was the number of on-farm machines, however.[121] Another US study suggested that other factors such as the number of hours worked have a greater influence on machine-related farm injuries than farm safety policies.[123] The problem may be that policies are not always followed. It has been shown that knowledge and understanding of safety messages are often insufficient to change behaviour and attitude.[119] It has also been observed that farmers with a previous injury limiting their ability to farm were at increased risk of accidental injury while at work[124, 125] although this finding has not been universal.[126]

It is not easy to quantify the effectiveness of most safety policies in practice. One reason is that safety measures are often only advisory, not backed by legislation, so implementation is sporadic (nor does legal onus always ensure implementation). Data from a survey of over 900 farmers in England and Wales suggest that about two thirds of farmers of smaller farms, for whom written safety policy statements or documented risk assessments were not required, did not carry out any formal risk management.[117]

A further complicating factor is the increasing use of contractors or other casual labour.[117] It is possible that the use of contractors could make the industry safer if they act as 'specialists' doing particular tasks. On the other hand use of untrained casual labour at busy times could have the opposite effect. In a questionnaire survey to farmers in England and Wales, there was a tendency for casual staff not to receive the same level of health and safety management practice as regular staff, for example not getting PPE.[117]

In addition there are few fatal injuries relevant to each safety measure so numbers are likely to fluctuate annually and the number of non-fatal injuries is not known with any accuracy. Therefore it is difficult to monitor change in injury rate and to attribute this to a safety policy.

There are some exceptions. For example, roll-over protection structures (ROPS) for tractors have been implemented with support by legislation in the UK and other countries.[127] Data from Northern Europe[128] and the USA,[129] have demonstrated a dramatic decline in the annual rate of fatalities from tractors over-turning following successful implementation of this intervention.[130]

2.4.6 Conclusion

It would be helpful to know more about non-fatal accidents and their association with particular types of farming activity as well as their importance in terms the impact of resultant disability on capacity to work. Most agricultural workers are either self-employed or work in small enterprises, and very few have access to occupational health services. With better knowledge about the frequency and patterns of occupational injuries in farmers prevention could be prioritised and better targeted.

2.5 Musculoskeletal disorders

A wide range of musculoskeletal disorders have been linked to activities in the workplace. In farmers, hip osteoarthritis has been identified as a particular problem.

2.5.1 Hip Osteoarthritis

In England it has been demonstrated that men working in agriculture are unusually prone to hip osteoarthritis,[37, 131] a finding that is supported by similar studies from several other countries.[132, 133] The observation is remarkably consistent and relative risks of 2 to10 have been reported.[132] Studies suggest that as many as one in five farmers will have a hip replacement.[37] This is much higher than in the general population. A survey covering six general practices in Avon, Somerset and Oxfordshire suggested an overall prevalence of elective hip replacement, in subjects aged 65 years and over, of around one in nineteen.[134] Other studies suggest that the need for hip surgery in the general population is of a similar order of magnitude.[135, 136] The excess risk has not been attributed to any one type of farming.[37] The results of a population based survey in the Peak District and Cheshire suggested that the increased risk is not an artefact of farmers presenting earlier because they are more handicapped by the disease (i.e. selection bias) but rather that it is a true occupational hazard.[37]

Agriculture is a physically demanding occupation and was even more so in the past and there does appear to be an association with prolonged periods of frequent heavy lifting, in agriculture[37, 131, 132] and in other occupations.[57, 137, 138] Prolonged standing may also be important.[131] Other contributory factors that have been proposed include vibration from tractors, lifting of lighter loads, and the age at which lifting started, but there is less evidence for their importance.[37] It is postulated that the hip may be particularly vulnerable to stress when the hip joint is not fully developed,[132] but the strong correlation between age of starting work and years spent in agricultural work makes it difficult to distinguish which is more important.[37] Further studies will be required to ascertain whether increasing mechanisation, and hence less heavy lifting, will be associated with a fall in hip OA in farmers.

2.5.2 Back pain

Back pain is the most prevalent occupational health problem experienced by much of the world's workforce.[139] A Manchester based population study found the 12 month cumulative incidence of new consulting episodes for back pain was 3% in males and 5% in females and for new non-consulting episodes, 31% in males and 32% in females.[140] The prevalence of reported back pain is increasing. The results of two prevalence surveys in Britain, 10 years apart, suggest an increase in back pain of 12.7% over that period,[141, 142] though severe back related disability had not increased.[141] The amount and socio-economic consequences of work absence resulting from low back pain are a concern in the UK and other countries.[143] In a Norwegian study it had a greater effect on reducing quality of life than other musculoskeletal symptoms,[144] and in England, while most patients do not go on consulting their GPs, they may continue to experience pain and disability for a year or more.[145] In a Swedish study the prevalence of low back problems in male farmers was approximately 1.5 times that in other working men.[146]

Data from Finland suggest that one of the most common causes of work disability in farmers is low back disorders.[15] There has been no specific work on the prevalence of back pain in farmers or the impact on their capacity to work in the UK, but in several countries, whole body vibration (WBV) in tractor drivers has been identified as a cause of back pain. WBV is experienced when vibration from vehicles is transmitted through the human body. The natural resonant frequency of the human body is 4-8 Hz and the lumbar vertebrae have a resonant frequency of 4.4Hz. The frequency of tractor vibration is reported to be in a similar range of 1-7Hz, therefore potentially amplifying body vibration. The most frequently reported adverse effects are low back pain, early degeneration of the lumber spine and herniated lumbar disc.[147]

While several studies have addressed the effect on the back of vibration from tractors, they have generally lacked adequate controls.[148] These studies consistently suggest that long-term exposure to WBV is harmful to the spine.[147] However, the mechanisms giving rise to back pain are still unclear.[149, 150] For example, a Dutch study of self-reported back pain in tractor drivers found that reported pain was higher in tractor drivers than drivers not exposed to vibration, but concluded that while WBV may be a factor, prolonged sitting and (twisted) posture may also have an influence,[151, 152] as may other farming activities.[153]

In Australian farmers, tractor driving was also most frequently described as the factor associated with an increase in self-reported neck pain and headache. These symptoms were common in this study population, 79% and 77% respectively, and were thought to be associated with whole body vibration and rotated neck posture.[154]

The British Standard action level for estimated daily personal dose of vibration (eVDV) of 15ms$^{-1.75}$ has been estimated to be exceeded in over 383,000 persons in Great Britain. Occupations in which exposure was thought most often to exceed the British Standard included farm owners and managers and farm workers. Others were forklift truck and mechanical truck drivers and drivers of road goods vehicles.[155]

Tractor vibration is affected by terrain and speed and can be severe. The vibration can be reduced by appropriate suspension systems,[156] so if there is a clear health effect there may be engineering solutions.

Several other mechanical and psychosocial factors are associated with back pain. In studies of Colorado farm workers, back pain was associated with working in agriculture for 10 years or more,[139] repeated physical activities in farming (lifting, pulling, bending twisting and reaching) and less commonly, single incidents such as slipping and falling.[157] Depression was also significantly associated with back pain.[139]

Lifting or bending and twisting and exposure to vibration have also been identified as precipitating factors for back pain in other occupations.[158-160]

In patients presenting with back pain, pre-morbid factors associated with an increased risk of persistent problems have included female sex, older age, psychological distress, below average self rated health, low levels of physical activity, a history of low back pain, current or previous smoking, a low alcohol intake, not being employed and a dissatisfaction with current employment or work status including monotonous work,[140, 159-161] high abnormal illness behaviour scores,[159] being depressed[139], and low educational level, low social status, low household income or perceived inadequacy of income.[140, 162, 163] Even with sciatic pain, while physical workload factors seem to be involved in the onset of pain, psychosocial factors are related to persistence of symptoms.[164] In fact some people argue that chronic disability in back pain is primarily related to psychosocial dysfunction.[165]

While disability from back pain has increased in the last half century, physical activity e.g. manual handling has decreased. However some risks such as monotonous sedentary work or dissatisfaction with workplace have increased.[142] General cultural influences may have affected awareness and reporting of symptoms. Potential compensation, for industrial injury, from civil claims or sickness benefit may also increase the reported prevalence of work related problems. However these benefits are less likely to be available to self-employed workers, and so will not apply to most farmers in the UK.

2.5.3 Other symptoms

Various other musculoskeletal disorders are associated with one or more occupations, but it is not clear how important they are in agricultural workers.

Knee osteoarthritis

In some countries knee osteoarthritis has been identified as a problem in farmers, but this has not been demonstrated in the UK. It is a common cause of work disability in Finnish farmers[15] and a Swedish cohort study of occupational groups coming to arthroplasty found an excess of male farmers.[133] However a study on the prevalence of musculoskeletal disorders in Swedish male farmers did not find an excess of knee arthritis compared to age matched economically active men.[146] The risk factors for OA knee are different from those for OA hip, obesity being a more important factor.[166] There are mechanical risk factors that are relevant to some occupations. OA knee is associated with prolonged squatting, kneeling and stair climbing. Lifting in association with stair climbing has also been associated with an elevated risk in one study.[167]

Shoulder pain

Shoulder pain has not been identified as a problem in farmers in the UK, but neck and shoulder disorders are a cause of work disability in Finnish farmers,[15] and found to be slightly more common in Swedish male farmers than other working men, along with hand and forearm symptoms.[146] A variety of occupational physical demands and psychosocial factors relevant to other occupations have been associated with shoulder pain. In a survey in Manchester of selected occupations, (that did not include farmers) manual handling activities that were found to be significantly associated with disabling pain were lifting weights above shoulder level, duration of lifting weights with one hand, pulling weights and carrying weights on one shoulder. However psychological stress, working in a psychologically demanding environment whether hectic, boring or stressful, also significantly increased the risk of disabling pain.[168] As might be expected the prevalence of pain was higher in older age groups (38+)[168] and the increased risk has been shown to persist after retirement in postal workers.[138]

2.5.4 Conclusion

There is good evidence that osteoarthritis of the hip is associated with farming possibly due to heavy lifting. However there are still uncertainties concerning the importance of other risk factors, including lifting moderately heavy loads, duration and frequency of lifting and the relevance of age when starting work involving possible risk factors for OA hip.

The association between farming and other musculoskeletal disorders is less clear. Investigating the epidemiology of back pain is complicated. Diagnosis depends on subjective report of symptoms and is influenced by psychosocial variables as well as physical. While the nature of farming suggests that farmers are a high-risk group, because of mechanical risk factors, the influence of back pain on capacity to work has not been investigated in UK farmers.

Similarly, no association between farming activities in the UK and OA knee or shoulder pain has been demonstrated, but data from Nordic countries suggest that these disorders are a common cause of disability among farmers. It would be interesting to investigate the association between heavy lifting and OA hip as well as other musculoskeletal disorders in a single study.

2.6 Abdominal Hernias

Abdominal hernias are common worldwide. Most abdominal hernias are classified into three types, inguinal, femoral and ventral hernia. Inguinal hernias are the most common and make up 75- 80% of all hernias and usually occur in males.[169, 170] Data on incidence and prevalence in the UK are lacking, but in the financial year 2001/2 around 70,000 operations for inguinal hernia were performed in England under the NHS, and a further 70,000 were on the waiting list for surgery.[171] In the USA, the prevalence of hernia in adults is estimated to be around 5% in adult males and 1% in adult females[169].

The main serious complications from abdominal hernia are obstruction or strangulation for which urgent surgery is required. The frequency of complications has not been documented but during the year 2001/2 over 4000 emergency admissions for inguinal hernia were recorded in England and almost 5000 for other abdominal hernias. Some deaths do occur. In 2000, in England and Wales, 621 deaths were coded to an underlying cause of hernia of the abdominal cavity (ICD9 550-553).[172] There are no data on how many deaths were postoperative, (the National Confidential Enquiry into Perioperative Deaths does not look specifically at causation[173]) but it is likely that most occurred in hospital. Even for the general category of diseases of the digestive system (ICD9 520-579) over 85% of the deaths in 2000 occurred in hospital.[174]

Statistics from the United States suggest that hernia is a frequent cause of lost work time.[169] According to the 'Annual Survey of Occupational Injuries and Illnesses' from the Bureau of Labor Statistics in 1994, which collects data on injuries, illness and hours worked from a random sample of 250,000 private industry establishments, the overall annual incidence rate of hernia in males was 6.0 per 10,000 workers, the tenth most frequent illness ascribed to occupation by employers.[169] Corresponding statistics for the UK are not available as hernia is not reportable under RIDDOR, nor is it included in reports of the UK survey of self-reported work related illness.[175]

However, for England and Wales, mortality statistics do suggest that death attributable to hernia is more common in farmers than other occupations, particularly for inguinal hernias. The PMR for inguinal hernia (ICD9 550) in male farmers aged 20-74, for the years 1979-80 and 1982-90, was 191 (95% CI 137-259) overall, and 243 (95% CI 142-390) in self-employed farmers. The number of deaths was small, however. Over nine years, 41 deaths from inguinal hernia were recorded in male farmers and 41 deaths from other hernias. The corresponding numbers for female farmers and farmers' wives were 1 and 58 respectively.[83]

Interestingly, hernia does not feature as a cause of death in mortality studies on farm workers in other countries,[176-178] suggesting that either PMRs[177, 178] for hernia were unremarkable and not reported on, or that this cause of death was not considered specifically.

The nature of farming work may be a factor in the relatively high mortality from hernia observed in England and Wales. Whether the condition is more common in British agricultural workers or whether they present late with complications and/or do less well following surgery has not been investigated. Annual survey data from Ohio, USA suggest that the incidence rate in agricultural occupations is lower than for all occupations (4.7 compared to 6.0 per 10,000 workers in 1994, a rate ratio of 0.63). However, this statistic cannot be generalised to the UK as the survey excluded self-employed people and farms with fewer than 11 employees, and the reported hernia cases were only those thought to be work-related by the employer.[169]

A number of factors are thought to influence the development of abdominal hernia including predisposing anatomical weakness, position when walking, and increased intra-abdominal pressure such as from coughing or lifting. It has been argued, based on case studies, that physical activity itself does not cause primary or recurrent inguinal herniation.[179] However, there is some evidence that lifting may be a precipitating factor for inguinal hernia. Heavy lifting has been shown to increase visceral pressure[180] and there is a theory that the type and frequency of lifting may influence the appearance of a hernia.[181] A Spanish case-control study demonstrated an association between repeated heavy lifting over long periods of time and inguinal hernias.[182] The cases were also significantly more likely to be poorly educated manual workers, have chronic cough and high alcohol consumption.

Another Spanish case-control study has demonstrated an association between hernia repair and occupational category (occupations categorised according to lifting effort). And within categories, the time spent lifting was higher in cases. In this study agriculture was in the medium effort category. In Ohio, USA, routine statistics on occupational injury and illness were used to calculate hernia incidence rates for industrial and occupational categories. Rate ratios of hernia incidence were highest in industries and occupations involving manual labour, though farmers were not reported specifically as being a high-risk group,[169] possibly because of the limited inclusion of subjects as discussed above. Earlier investigations did not implicate work or lifting as an important factor in the aetiology of hernia.[181, 183, 184]

In conclusion, there is some evidence that repeated heavy lifting may be associated with the development of abdominal hernias and that hernias are more common in occupations involving repeated heavy lifting. However, evidence from other countries does not indicate that farmers are a particularly high-risk group.

In order to plan possible interventions it would be useful to determine the relative prevalence of hernia in occupational groups in England and Wales, the association between physical activity at work and hernia, and also whether there are differences between rates in employed and self-employed agricultural workers.

2.7 Noise-induced hearing loss

Noise-induced hearing loss occurs with prolonged exposure to noises above 85dB(A). (Decibels measured on the A scale incorporate a weighting that takes into account the response to sounds at different frequencies). If exposure is short or intermittent, hearing will recover. Permanent damage to hearing occurs when the cochlear hair cells are not given sufficient time to recover. (There is no universal agreement on recovery duration.) The resulting hearing loss is cumulative and irreversible and results from the destruction of cochlear hair cells in the inner ear causing a sensorineural deafness which is usually most severe for the frequencies around 3-4 kHz. This pattern can differs from that of presbyacousis, where with increasing age, progressively larger losses are registered through bands of increasing frequency. Noise-induced hearing loss is usually similar in each ear, and if noise exposure continues, becomes severe enough to affect a person's ability to hear and understand speech.[185] Even mild high frequency loss may impair speech discrimination, particularly in noisy listening situations.[186]

Hearing loss may also follow acoustic trauma. This occurs when a person is exposed to a single sudden sound above 140dB(A), for example gunfire or an explosion. In this case hearing loss is usually most severe in the ear nearest to the sound.[185, 187]

Occupational hearing loss is a recognized hazard in jobs involving use of noisy machinery or other equipment. Data from a large cross sectional survey suggests that occupational noise exposure is responsible for severe hearing difficulties in an estimated 179,000 people aged 35-64 years in Great Britain.[188] Foundry labourers, members of the armed forces, builders and printers are among occupational groups with high reported rates of hearing loss.[189] Agricultural workers are potentially exposed to prolonged or high noise levels from use of firearms, tractors and other noisy machinery, but less complete data are available concerning the impact on their hearing than for some other occupations in the UK.

Two sources of information on noise-induced occupational hearing loss in the UK are compensation claims and the surveillance scheme for work-related hearing loss in the UK, (Occupational Surveillance Scheme for Audiology Physicians (OSSA) and Occupational Physicians Reporting Activity (OPRA)). Based on compensation claims, noise induced hearing loss is one of the most common reasons for claims across all occupations. However, such claims are less reliable as an indicator of prevalence among occupations in which a large proportion are self-employed, such as in agriculture. Under the surveillance scheme, farmers are included among those with a high rate of occupational hearing loss but the reported rate of 2.0 per 100,000 is lower than other occupations that might be expected to have a similar noise exposure e.g. builders 19.3 per 100,000, crane and hoist operators 6.8 per 100,000.[189] Most agricultural workers will not have easy access to occupational physicians, and as a high proportion are self-employed they may be less likely to report problems before they become incapacitating.

Specific studies of hearing loss among farmers in the UK have not been reported, though studies from USA, Canada and Poland have shown that farmers have a greater high frequency hearing loss than can be accounted for by presbyacusis alone.[186, 190, 191, 191-193] Estimated average noise exposure based on hearing threshold levels in Wisconsin farmers, aged 16-85 years, was 95db(A) in males and 80db(A) in females.[186] Factors contributing to hearing loss have been studied in New York dairy farmers whose mean ages, in three studies, were 43-46 years.[185, 194, 195] Lifetime exposure to noisy farm equipment and having a noisy non-farm job, with or without hearing protection, were significantly associated with hearing loss.[185, 194, 195] When only high frequency hearing loss was considered in a subset of volunteers, older age, male gender and a history of working in noisy jobs other than farming were the most significant associations. Other variables found to be associated with self-reported hearing loss or loss at other frequencies were years of hunting, years of grain dryer use, lower level of education, self-report of pesticide spraying in previous years,[196] male gender[185, 196] loss of consciousness due to head trauma, and being from a livestock farm.[185]

While hearing loss is significantly greater in older age groups, it appears that the trend may be established as early as the third decade,[192] and possibly in childhood[197]. Based on audiograms in North American farmers it has been estimated that at the age of 30, 10-25% have a communication handicap due to hearing loss. The figure rises to 50% at the age of 50.[186, 192]

It would be useful to assess to what extent agricultural work in the UK is associated with an increased risk of hearing problems and to be able to identify important risk factors so that appropriate advice can be given.

2.8 Respiratory and atopic diseases

Work related respiratory symptoms are common in farmers. In the European Farmers' Project, a cross-sectional study of nearly 8,000 farmers in five European countries, almost one third of the UK sample, all from Essex, reported work-related respiratory symptoms (wheezing, breathlessness, and/or cough without phlegm during work). This was high compared to the prevalence in other centres. The overall prevalence was 22%, but the UK sample was relatively small, only 131 participants.[198] Various types of respiratory illness are linked to work in agriculture for example, exposure to dust on farms has been associated with asthma, rhinitis, allergic alveolitis, organic dust toxic syndrome (ODTS) and chronic bronchitis.[199]

2.8.1 Extrinsic allergic alveolitis

Extrinsic allergic alveolitis is a term applied to a number of conditions in which the inhalation of organic dusts results in hypersensitivity reactions at the alveolar level (interstitial pneumonitis). Examples include farmers' lung disease due to thermophylic actinomycetes species, especially *Micropolyspora faeni* in mouldy hay, mushroom workers lung in which thermophylic actinomycetes are suspect, and bird fanciers lung due to antigens in avian excreta and serum. After repeated exposure to the antigen concerned, a common pattern of clinical features occurs.

The most common type of extrinsic allergic alveolitis in farmers is farmers' lung disease or farmers hypersensitivity pneumonitis. Symptoms are most prevalent in cold wet climates that favour fungal growth, and in winter months when stored crops are used for animal feed. The classical acute type presents with dyspnoea, shivering, fever and cough occurring fairly suddenly some hours after exposure to mouldy hay. Chest X-ray may show faint miliary mottling. Symptoms and X-ray changes usually resolve within three to four weeks but re-exposure leads to recurrence and development of a subacute phase in which clinical and radiographic resolution occurs more slowly. Some cases pass into a chronic phase and develop severe exertional dyspnoea and cough. Death can occur from *cor pulmonale* and right-sided heart failure.

Lymphocytic infiltration of the alveoli is typical of the acute phase of the disease, but with progression, fibrotic changes are seen on X-ray. The presence of antigen-antibody immune complexes has been well documented, suggesting that an intrapulmonary type III hypersensitivity reaction may be responsible for acute symptoms. Granuloma formation has also been described, more typical of a cell mediated, type IV reaction, so the allergic mechanism in the chronic phase appears to be more complex.[200]

The frequency of extrinsic allergic alveolitis in farmers is uncertain. The Surveillance of work related respiratory disease (SWORD/OPRA) surveillance schemes, by which chest physicians and occupational physicians report cases of work related respiratory disease, indicated an estimated average of 39 new cases of occupational allergic alveolitis per year, in the UK, during the period 1999 to 2001. By far the highest annual rates, by industry, of allergic alveolitis reported to SWORD were in farming or veterinary activities, where the attributable agents were mouldy hay, mushroom compost dust or avian proteins. Another source of information is the number of Disablement Benefit cases, but far fewer cases are recorded as claiming benefit than the SWORD surveillance scheme would suggest. One possible explanation is that farmers, who constitute the largest group of sufferers, are often self-employed and therefore ineligible for compensation[201]. A pilot study in the 1970s, of farmers in Scotland, found regional differences in the prevalence of farmers' lung disease, probably related both to climatic conditions and differences in agricultural methods. In this study prevalence rates between 23 and 86 per 1000 farmers were estimated in three regions based on symptoms. If cases with a negative antigen precipitin test were excluded the estimated figures were reduced to a range of zero to 43 per 1000 farmers, which was still high compared to other estimates.[202] A positive *M. faeni* precipitin test is not specific for farmers lung disease, however.[6] The incidence of acute symptoms in Swedish farmers has been estimated at two to five per 10,000 per year.[203]

Only fifty-six deaths from farmers' lung disease were recorded among male farmers, aged 20-74, in England and Wales in the eleven years 1979-80 and 1982-90. There is obviously a problem comparing deaths from a disease defined by occupation, but based on an analysis of these deaths, the PMR for male farmers compared to other occupations was over 1000. Even for 'other unspecified allergic pneumonitis' the PMR was over 500.[83]

Though farmers' lung disease appears to be relatively rare, it is important because it is potentially a serious and disabling disease and there are preventive measures that can be taken. These include adequate drying of crops, use of open pit silage and forced ventilation in working areas, use of mechanical feeding systems and use of anti-mould preparations. Sensitised persons should be warned to minimise further contact with mouldy hay, grain or straw and to use respirators for high-risk activities.[200, 202]

2.8.2 Organic Dust Toxic Syndrome (ODTS)

The syndrome known as ODTS is an acute inflammatory reaction of the airways and alveoli. The symptoms (breathlessness, fever, cough and malaise occurring four to six hours after exposure to organic dusts) resemble the acute form of extrinsic allergic alveolitis. However, in general the individual recovers within 36 hours without need for treatment. The precise mechanisms underlying the disease are unclear. ODTS seems to be common in farmers, particularly pig farmers,[204] though crop farmers cultivating oil plants also appear to be at excess risk.[198] Because ODTS is self-limiting and does not feature in routinely collected statistics, its prevalence, resulting morbidity and impact on work are unclear. A review of studies in Sweden and other countries reported 5 to 20% of swine confinement workers experiencing symptoms consistent with ODTS.[205] The prevalence is likely to vary with climatic conditions. In Sweden attacks were found to be most common in autumn, usually provoked by handling mouldy grain,[206] and could be precipitated by occasional heavy exposure to mould dust, unlike extrinsic allergic alveolitis which appeared to require repeated exposure.[203] As with allergic alveolitis, education, dust control and use of properly maintained respiratory protection are important in prevention.

There appears to be no literature concerning ODTS in farmers in the UK and the impact of this condition on health and work in agricultural workers in this country is not known.

2.8.3 Asthma

Several large studies have been conducted in recent years in different countries looking at asthma in groups of farmers. These studies have produced conflicting results regarding the prevalence of asthma and wheezing in farmers compared to the general population, but overall suggest that the prevalence of asthma is no higher in groups of farmers than in the general population,[207] though high when compared to professional, clerical and administrative occupations.[208] A large European study indicated that the prevalence of asthma was similar to the population overall,[209, 210] whereas in New Zealand farmers appear to have a lower prevalence of asthma than the general population,[211] and in Germany sheep breeders have been shown to have a high prevalence of asthma related symptoms.[212] In Sweden and Finland data from registries of occupational diseases also suggested a higher prevalence of asthma in farmers compared to other occupations.[213, 214] This was supported by the findings of a population-based study of people age 20-44 years, in 26 areas of twelve industrialised countries, in which farmers and agricultural workers (considered as separate occupations) were both among the six occupations with the highest risk of asthma. Asthma was defined as bronchial hyperresponsiveness and reported asthma symptoms or medication.[208] In the UK, based on cases of occupational asthma reported by chest physicians to SWORD from 1999 to 2001, the estimated rate of occupational asthma in agriculture, hunting and forestry was lower than for most manufacturing industries, but higher than for all industries. However this estimated rate of 4 per 100,000 workers per year, for the agriculture industry was based on fewer than 10 cases.[215] In Swedish men the Standardised Mortality Ratio (SMR) for asthma among farmers according to mortality data for 1971 to 1992 was significantly increased.[213, 216] It has been proposed that this might be partly due to reduced access to medical care because of geographical or social factors,[207] as well as to occupational factors.[213] In the UK, a study of mortality reported no elevation of PMR for asthma among farmers for the years 1979 to 1980 and 1982 to 1990.[16, 83]

It appears that being raised on a farm can protect children from asthma. In particular, there is evidence that exposure to livestock in childhood is an important protective factor.[9-11, 217-220] The prevalence of type I hypersensitivity (on skin prick testing) to local common allergens has been found to be lower in farm children in several studies,[10, 207, 218] although the evidence for protection from allergic sensitisation is less consistent for asthma than for hay fever. It has also been suggested that dietary factors or other aspects of rural living may be important, but these have been studied less.[220]

One hypothesis concerning the mechanism of protection is through exposure to endotoxin (bacterial products such as lipopolysaccharides). These substances engage with antigen-presenting cells eliciting strong interleukin (IL-12) responses. These in turn stimulate maturation of T helper type 1 cells. There is some supporting evidence for this from blood samples in infants, in which endotoxin levels to house dust mite were found to be significantly lower in sensitised compared to non-sensitised infants. The endotoxin levels also correlated with IFN-γ (interferon-gamma) producing T cells (T helper type 1), but not with IL-4, IL-5 or IL-13 cell proportions (T helper type 2).[221] Atopy is characterised by a predominance of T helper type 2 (Th2) cells and predisposes to asthma.[222] In animal studies it has been shown that shifting the Th1/Th2 balance to down regulate Th2 response, via different mediators, results in suppression of Ig E production, eosinophilia and airway hyperresponsiveness.[223-225]

On the other hand, farm work such as grain harvesting[226] or work in greenhouses[227] may predispose to allergic symptoms. Associations between several farm exposures and the presence of asthma or wheezing have been identified and include flower growing, working with horses, pigs, poultry, and growing oats, rice and alfalfa hay.[207, 228] Age and duration of exposure may be factors. A Danish study of farming students found no association between occupational farming exposure and asthma, but as might be expected, there were associations of asthma with smoking and family history of asthma or allergy.[229]

The most frequent allergens giving a positive response on skin testing in symptomatic farmers appear to be storage mites, followed by cow epithelium and flour dust,[230, 231] although in a study of Finnish dairy farmers, sensitisation was common among symptomatic and non-symptomatic farmers and reactions to skin prick tests were of limited value in distinguishing between them.[232] Similarly, in an English study, immediate type I weal reactions to extracts of fungi isolated from combine harvester dust, were produced in most symptomatic farmers and many non-symptomatic ones. In this Lincolnshire based study, carried out in the early 1970s, high concentrations of fungal spores were measured in the airborne dust around combine harvesters, and nearly a quarter of farm workers complained of respiratory symptoms while driving combine harvesters or working in confined spaces in grain bins or near grain dryers and elevators. Symptoms included acute wheezing and breathlessness as well as cough and delayed breathlessness without wheezing during exposure. Both atopic and non-atopic farmers were affected so the pathological mechanisms were not clear and may have included hypersensitivity to spores as well as physical effect of high dust concentrations.[233]

In conclusion, available data do not suggest that occupational asthma is a significant problem among UK farmers. However it is possible that some workers, particularly those not exposed to allergens in early life, may be at an increased risk of symptoms because of work exposures. It is not really known whether exposure to antigens common in agricultural settings are the cause of allergic respiratory disorders, nor whether exposure to antigens, such as soya bean dust or other types of grain dust, that are known to cause asthma in other settings, can cause occupational asthma an allergies in farmers.[207] In addition the effect of geographical and social factors on the diagnosis, routine treatment and emergency care, in farmers who have symptoms of asthma is not clear.

2.8.4 Other atopic diseases

Several types of farming, including grain and livestock farming have been associated allergic rhinoconjuntivitis (hay fever). The development of hay fever appears to be associated with an increased risk of asthma.[214, 234]

In common with asthma, allergens most frequently associated with occupational allergic rhinitis in Finland from 1980 to 1987 were cow epithelium, flour dust and storage mites,[85, 231] and in Scottish farmers who reported allergic symptoms on entering barns, around one fifth were positive to storage mites on skin prick tests.[235] In a survey of over 1500 Swiss farmers it was established that poultry, pig and cattle farming were risk factors for reporting nasal irritation at work, poultry farmers experiencing the highest prevalence.[236] However, while agricultural workers are exposed to many type I allergens, the prevalence of self-reported nasal allergies, including hay fever, among farmers in European Countries has been found to be considerably lower than estimates for the general population.[207, 226, 236]

As with asthma, a reduced risk of hay fever in children from farming families, as compared to their peers from non- farming families, has been observed in several countries. The general increasing trend in atopic diseases (dermatitis, allergy on skin testing) and allergic rhinitis has not been observed in farm children.[221] The presence of livestock seems to be an essential part of the observed protective 'farm effect'.[9-11, 217, 221] Early exposure also appears to be important. In a cross-sectional study of over 800 children in Austria, Switzerland and southern Germany, the risk of ever having asthma, current asthma symptoms, and atopic sensitisation was reduced by approximately one third if a child had been exposed to stables during the first year of life compared to the first exposure to stables during school age or no exposure. In addition the consumption of farm milk in the first year of life was independently associated with a risk reduction for atopic asthma and sensitisation.[11] Overall studies in farming populations show more consistent protection from hay fever and allergic sensitisation than asthma.[221] It is not clear if the protective effect extends to adulthood.

2.8.5 Chronic bronchitis

Chronic bronchitis is defined as cough and phlegm for three months or more per year during the past two years. Most studies reporting chronic bronchitis in farmers use this definition. There is evidence from studies outside the UK that the prevalence of chronic bronchitis is higher in farmers than in the general population. For example, in Saskatchewen, Canada, after a correction for smoking exposure the prevalence of chronic bronchitis in farmers was 11.1% compared to 7.7% in community control non-farmers.[237] It appears that factors associated with farm work may be more important in the occurrence of chronic bronchitis than socioeconomic background[238]. In most countries, though not in the Canadian study,[237] farmers have a lower prevalence of smoking than the general population, so if there is a high prevalence of the condition in farmers it must be related to other factors. In French dairy farmers, who have been shown to have a higher prevalence of chronic bronchitis compared to non-farmers, the difference was found to be greater in non-smokers.[239] It has been proposed that exposure to dusts or chemicals in the farming environment can cause effects on the tracheobronchial tree that are separate from the effects expected by exposure to cigarettes.[237] This could be an immunological response to microbial antigens such as endotoxins or fungal products.[226] Smoking may have an interactive effect in some instances though. In female Canadian grain farmers it was found that the prevalence of chronic bronchitis increased more rapidly with increasing cigarette consumption than in non-grain farmers. However, in men the effect of grain farming on symptoms appeared to be independent of smoking history.[240] In a Finnish survey conducted between 1979 and 1982, atopy (positive reactions to challenge tests) predisposed to, and had an additive effect with smoking on chronic bronchitis in farmers.[3]

A number of studies, mainly from non-UK, European countries, have looked at the prevalence of chronic bronchitis in specific groups of farmers. In general the occurrence of symptoms related to farming types in which grain crops, including animal feeds were handled.[3] Exposure factors of importance in a large cohort of Norwegian farmers were full-time versus part-time farming, livestock production types (poultry, dairy, swine and horse combinations) and dust exposure outside agriculture. In combination, these factors were associated with an increase in chronic bronchitis of, up to three fold. In exposed smokers the risk doubled again.[241]

Animal confinement work does appear to be a significant risk factor. The prevalence of several respiratory symptoms or symptom complexes, including chronic bronchitis appears to be high in pig farmers. In a survey of Danish farmers, the prevalence of chronic bronchitis in pig farmers was 32%, and compared to other farmers the odds ratio for chronic bronchitis was 1.53.[242] In Sweden, compared to non-confinement swine producers, those working in swine confinement buildings were seven times more likely to suffer from chronic bronchitis.[243]

The importance of specific risk factors appears to vary between countries. Finnish cattle farmers did not appear to be at an excess risk for chronic bronchitis,[244] whereas French dairy farmers did.[239, 245] Barn drying of fodder, which takes place on the more modern farms in the Doubs region of France did not appear to protect against chronic bronchitis, though may have had some benefit in reducing other respiratory symptoms and improving lung function tests.[246] In a survey of respiratory health in over 2000 randomly selected farmers in New Zealand, the odds ratio for chronic bronchitis was significantly higher in those handling hay and horses than farmers not handling these.[247] Sheep breeders in Germany had a high prevalence of chronic phlegm compared to farmers in the European Farmers' study (prevalence odds ratio 4.0 CI 2.8-5.9).[212]

In the UK, chronic bronchitis is a common condition but there is little information on the importance of the condition in farmers. Community prevalence surveys were carried out on agricultural populations in areas of Scotland and Wales in the 1950s. The overall prevalence was not significantly different in the two areas, and was similar to that in the non-mining population from an industrial area in Lancashire.[248, 249] In these early studies of agricultural communities occupational risk factors for chronic bronchitis were not identified. Smoking rates are relatively low in British farmers[6, 250] and it is possible that the protective effect of lower smoking prevalence may mask a higher risk in some groups. Better information on chronic bronchitis and associated occupational risk factors may help target prevention if associations are demonstrated.

2.8.6 Respiratory infections

Mortality data from European Countries for periods in the 1970's suggested that agricultural workers in France and England and Wales suffered an excess of acute respiratory disease deaths, mainly from pneumonia and influenza,[251] and more recent data for England and Wales suggests that this is still true.[16, 83]

It is not known how much of the increased risk is related to infections being more common in farmers, possibly associated with outdoor work in extreme weather conditions, and how much attributable to delayed seeking of medical care.

Other specific respiratory infections recognised to be associated with animal contact, such as Q fever and bovine tuberculosis are rare and their link to work is generally investigated when they occur.

2.8.7 Asthma-like syndrome

An asthma-like syndrome has been described in poultry and swine confinement workers and grain workers. The main features are wheeze and breathlessness that tend to improve as the working week progresses. Grain, cotton dust, ammonia and endotoxins have been implicated as causes.[200, 209 252-254]

2.8.8 Conclusion

Farmers are at increased risk of extrinsic allergic alveolitis and some respiratory infections. Asthma appears to be less prevalent in agricultural workers than in the general population, but both asthma and chronic bronchitis may be more prevalent in some sub-groups of farmers. A relatively low smoking prevalence reduces the risk of some respiratory conditions in farmers and early exposure to farm antigens appears to protect against atopic disease, though it is not clear if the protective effect extends to adulthood.

However there are occupational risk factors for respiratory disease, particularly organic dusts. Lung function and symptom studies do suggest that respiratory health may be affected by certain farming activities, particularly animal confinement work,[230, 255, 256] even with cleaner modern farming methods.[257] However the aetiology and pathology associated with many of these work related, respiratory disorders is unclear and the relationship between lung function tests and reported symptoms in studies is inconsistent.[250, 253, 258-264] There is relatively little information concerning more common respiratory conditions in farmers in the UK, where geography and climate differ from countries in which much of the research has taken place. Exposure to dusts has also been shown to be quite variable in different countries and farming environments.[265]

In order to target prevention, it would be useful to have more information on associations between respiratory disorders and nature of farming, length of time spent working on a farm, and whether residence on a farm in early life, or in later life, influences the prevalence of atopic disease, in the UK.

2.9 Other work related conditions

2.9.1 Hand – arm vibration syndrome

Another potential hazard in agriculture is hand-transmitted vibration (HTV). HTV is associated with a group of disorders that are known as hand-arm vibration syndrome (HAVS). Symptoms include vibration white finger (VWF), characterised by attacks of blanching (whitening) when the fingers become numb. Tingling and numbness caused by nerve damage and pain and stiffness in the hand, wrists, elbows and shoulders can also develop.[266-268] HTV usually arises from finger or hand contact with powered tools such as chainsaws, or from materials being held against a vibrating surface, such as a grinder.[268]

In some occupations, for example forestry, the risk of HAVS is well established. Farmers may undertake some forestry work or use powered vibratory tools in repair and maintenance work on their farms, but until recently there has been limited information regarding risk to agricultural workers. An analysis of data from a National Survey of Vibration found that 23.5% of farm workers in the sample reported exposure to significant levels of HTV during the previous week. This was high compared to blue-collar workers (17.4%) and white- collar workers (0.7%) in the sample studied.[269, 270] However the number of farm workers in this survey was relatively small (122). In the survey, moderately high risks of cold-induced finger blanching and sensorineural symptoms were found in farm owners, managers and farm workers, with prevalence ratios of 1.2 - 2.6 in comparison with unexposed occupations.[271]

Measures can be taken to minimise the risk of HAVS associated with tool use. Therefore it would be useful to confirm the prevalence of exposure among farmers in a larger sample and to estimate the number of cases attributable to occupational exposure.

2.9.2 Skin disorders

Occupational skin disorders that affect agricultural workers include contact dermatitis, infections such as orf, and skin cancer. However accurate information on the prevalence of skin disorders in agricultural populations and the resulting morbidity is limited.

In the UK, surveillance schemes for occupational skin diseases were developed in the 1990s, to which consultant dermatologists and occupational physicians report skin diseases (EPIDERM and OPRA).[189] Eight categories of skin disease that may be associated with or made worse by work are reported. They include contact dermatitis, contact urticaria, neoplasia and infections. Yearly rates of skin disease are calculated using employment figures from the LFS. The most common skin disorder reported for all occupations has been contact dermatitis.

Contact dermatitis

Based on EPIDERM/OPRA surveillance for the UK, there appears to be a lower incidence of contact dermatitis in agriculture and forestry than in other industries.[189, 272] While this scheme does pick up some cases of dermatitis in farmers, it is probable that only the most severe cases (requiring a specialists opinion) are identified. From February 1996 until January 1999, relatively few cases from farming were reported by occupational physicians.[272] This stems from lack of occupational health services for the majority of farmers and farm workers. When incidence rates for this period were calculated using only reports from dermatologists, there was a higher than average incidence in farming and forestry, although incidence rates calculated for two other industrial sectors, manufacturing and mining and social/personal services were still higher.[272]

Other sources of data suggest that contact dermatitis may be more common in agricultural workers. In the 1995 UK Household Survey of Self-Reported Work Related Illness, workers in farming, fishing and forestry were among the occupational groups with the highest rates of self-reported occupational skin disease.[175] However as discussed in section 2.4.3, once broken down by occupational groups and specific conditions the numbers reporting ill health are very small (nought to four cases per occupational group for work related skin disease) so prevalence estimates have wide, and overlapping, margins of error. Data collected in Finland and in the United States also consistently point to agricultural workers as having a high risk of occupational dermatitis relative to other industries.[272-275] In Finland the mean annual incidence of occupational allergic skin disease has been estimated as 64 per 100,000 farmers.[231]

Differences between self-reported disease and surveillance data may reflect patterns of self-referral or secondary referral. If farmers use general practitioners as their main source of care, their condition will escape detection by EPIDERM. By contrast, in Finland, it is mandatory for all physicians to report to the Finnish Register of Occupational Disease, and therefore cases will be captured through a report by the initial treating physician. Alternatively differences may exist in the types of contact allergens to which agriculture workers are exposed. For example plants elaborating *Rhus* antigens (genus *Toxicodendron*, including poison ivy and poison oak) are widespread in the US, and a frequent cause of severe dermatitis in farmers and foresters,[274] but are unknown in the UK.[272]

Data published from the EPIDERM/OPRA surveillance scheme does not include agents identified as causing dermatitis in farmers, but in gardeners, "other biological substances" were the causative agents in over half the cases. Other agents causing contact dermatitis in gardeners were petroleum products and less frequently, rubber or friction.[272] Specific aetiological factors have been identified in countries other than the UK, and include hops and crops (grain, hay, straw),[276, 277] cow dander,[277-280] tylosin, an antiobiotic used in pig feed in Australia,[281] pesticides,[63, 277, 282-285] rubber compounds,[282, 286] disinfectants[287] and plant impurities in grain feed.[288]

Exposures to irritants or allergens of farmers in these studies may differ from exposures experienced by farmers in the UK because of differences the nature of farming and use of protective equipment. Therefore it is not clear how important specific allergens and irritants are in the UK. However occupational dermatitis appears to be a widespread problem in farmers internationally. For example reactions to various pesticides have been reported in many countries including New Zealand,[282] Poland, [277, 283] Spain, the USA, Germany,[283] India,[284] Taiwan[285] and Ecuador.[63]

Occupational dermatitis in UK farmers is probably under-reported. It is not known whether the condition is also under-diagnosed and under-treated. One concern is that farmers may suffer excessively by continuing to work as usual, in spite of skin disease, because of the difficulties finding alternative jobs.

In order to help ascertain the importance of this skin problem in UK farmers it would be useful to have further information on self-reported dermatitis, including the type of medical attention sought, if any. There is also a need to determine associations between symptoms and type of farming and the influence of symptoms on capacity to work.

2.10 Impact of illness and disability on capacity to work

Because of the physically demanding nature of agricultural work, illness may impinge on ability to carry out work more than in many other occupations. Coping with illness may be particularly difficult because many farmers are self-employed, carry out most of the farm work themselves and do not receive statutory sick pay. Even for employees there may be no alternative employment on the farm. In a survey of farmers in England and Wales, 31% reported health problems that interfered with their work including more than a quarter of those under 50 years old,[14] but it is unclear how much of a problem disability and illness creates in farming and how it is managed.

There is a small amount of literature from countries other than the UK on specific conditions. It suggests that respiratory diseases and musculoskeletal problems are important causes of incapacity.

Respiratory diseases are common, and even if their aetiology is not work related, because of the nature of farm work, the implications of ill health may be greater than for workers in less physically demanding occupations. In a Finnish study on the consequences of respiratory disease in farmers, 15% of farmers who developed chronic bronchitis during a three year follow up (1979 to 1982), decided to reduce farming work, close down the farm or change the line of production on the farm, compared to 8% for healthy farmers. Farmers with farmers' lung disease or asthma were also more likely to give up occupational activities compared to the rest of the farming population. The authors estimated that in Finland, about 300 farmers per 100,000 and a total of about 600 per year reduce their farming work or stop farming due to respiratory disease.[289]

Musculoskeletal problems were an important cause of work disability among Finnish agricultural workers. In 1996, 77% of medical certificates for disability pensions included at least one musculoskeletal diagnosis, 38% included a cardiovascular disease and 11% a mental disorder.[290] An analysis of sick leave claims among Dutch self-employed farmers during the period 1994 to 2001 found that 61% of the claims were for musculoskeletal disorders and injuries, and approximately one third took three months or more to recover. However, in this study the slowest recovery was seen in farmers with respiratory diseases and those in oldest age category (over 45 years).[291] In a survey of back pain among residents of small Colorado farms, carried out in 1993 and 1996, 38% of men and 30% of women had made 'major' changes (undefined in the survey) in work activities, 10% changed their job and 8% stopped their job permanently because of back pain.[139] It is not clear how these statistics compare to other occupations nor to agriculture in the UK.

There is some information relating to time off following accidental injury. Data collected from England and Wales in the LFS, in 1997/8, suggest that the proportion of injuries leading to absence from work for more than three days was lower for agriculture than the average for all industries (20% compared to 32%). However, where the duration of absence exceeded three days, the mean number of days lost was higher for agriculture than in all industries combined (24 days compared to 19).[17] This could suggest that agricultural workers are less likely to take time off for more minor injuries, possibly because of practical, psychological and financial pressures to continue working, but when they do take time off they need to be off work for longer because of the severity of injuries that occur and their impact on capacity to work. This was supported by the results of a study in mid–Wales, of people presenting to their general practitioner for farming related accidents and injuries. In 70% of cases no time was lost off work as a result of the accident. Of the remainder, up to 170 days could be lost. In this study 75% of cases were managed in general practice and 25% referred to the nearest A&E department. [109] A social survey of farmers and their families in Northern Ireland suggested that 32% of farm accidents involved a month or more off work.[20]

It would be useful to know if men who work in agriculture are more likely to change job or stop working because of ill health than men in rural communities who work in other occupations, and whether being self-employed influences capacity to work.

2.11 What is being done to reduce work related ill health ?

A range of information on safety issues is available to farmers through the HSE either as leaflets on single issues such as seat restraints or use of big round balers or a more comprehensive guide on health and safety on the farm.[83] As discussed earlier, the provision of information does not always result in a change in behaviour, so more needs to be done. There are sometimes specific campaigns on preventing incidents that have been highlighted as a particular problem e.g. 'Think Before You Reverse', which has been advertised through the farm press in 2004 to try to reduce vehicle related accidents on the farm.[292] It is important that health problems causing high morbidity are identified so that campaigns can be focussed on the most important issues and their effect monitored.

In addition various other agencies have an interest in offering help and support to rural and farming communities. The support offered has tended to be on a small scale and local. Initiatives reported in the literature have relied on short term funding.[293, 294] The Institute of Rural Health supports work related to farming in Wales and there is a 'Powys Farm Accident Prevention Campaign'. This was financed by the local health authority and supported by the HSE and local farming groups. Schools, young farmers clubs and others are given talks on farm accident prevention with local media helping to pass the message on to the broader public. They also look into other issues such as design and comfort of PPE.[109]

In Cumbria a nurse practitioner-led farmers' health service was set up. This was a two year project which started in 1999, but a full evaluation of the project has not yet been published. The project targeted farm accidents, mental health and occupational diseases and employed two- full time nurse practitioners (from farming backgrounds). The work has involved publicising the service through local agencies, seeing patients either through self-referral or referral from other agencies such as GPs and the NFU, keeping data on consultations and inquires for feedback and collecting information on farm accidents.[294]

Another nurse led project focusing on mental health was reported in Wales suggesting that community health nurses are in a good position to address the mental health needs of the farming community.[293]

At present there is little information on the effectiveness of these initiatives. However, if resources are available, to identify the underlying causes of work-related ill health or accidents, and to address these is one way forward.

2.12 Strengths and limitations of available evidence

The purpose of this section is to consider the strengths and weaknesses of the data discussed earlier in this chapter.

2.12.1 Study Design

Most of the information I identified came from routine statistics and cross-sectional surveys. There were some case-control studies and an occasional a retrospective[36] or prospective[262] cohort study.

Routine Data

Important sources of routine data for UK statistics on occupational health include RIDDOR and occupational reporting schemes. These are useful for assessing comparative morbidity and mortality in different occupations if incidence rates are estimated. However a major problem is underreporting and more importantly differential underreporting between occupational groups. For example, self-employed farmers are less likely to see occupational physicians than workers in many other occupations so their conditions may be differentially underreported through occupational reporting schemes.

Even if reporting is thought to be complete (as for mortality), statistics for specific health outcomes may be misleading because of errors in the recording or coding of diagnoses. This appeared to be the case in the ratio of suicide verdicts to open verdicts in Devon compared to England and Wales, between 1984 and 1990.[353]

Some data tends to be available as numbers rather than rates and denominator data may be difficult to obtain or unreliable - for example, numbers of agricultural workers and farmers by sex.

Routine data collection may not be designed to investigate causation, or data bearing on causation may not be published. For instance, published data from the EPIDERM/OPRA surveillance scheme does not include the agents identified as causing dermatitis in farmers.[272]

Cross-sectional studies

Cross-sectional surveys are used to estimate prevalence of disease and/or risk factors. Many studies were of this design, which is relatively quick and inexpensive. It can be used to assess associations between disease and occupational exposures, provided that the disease does not cause affected workers to be selected out of the study population (which would cause a negative bias). A further possible source of bias is from errors in the assessment of exposures, especially if they are ascertained from memory. There may also be difficulty in interpreting this type of study because of uncertainties about direction of cause and effect.

Many of the cross-sectional surveys reviewed did not include an unexposed control population, so it was difficult to determine whether risks in farmers were excessive, and if so why. For example a postal survey of Northumberland farmers reported the proportion depressed based on the HAD score,[86] but it was not clear from that study how prevalence compared with that in the general population.

Case-control studies

Case-control studies are an efficient way to investigate risk factors, particularly where the outcome measure of interest is uncommon, for example OP poisoning.
A major problem with case control studies is the potential for bias, particularly when exposures are ascertained from memory. For example in the case-control study of osteoarthritis of the hip and occupational lifting by Coggon et al,[57] cases may have recalled their past exposure to lifting at work more completely than controls, causing risk to be overestimated.

2.12.2 Study size

While several large studies were identified (for example the European Farmers Project[198]), many were small (cross-sectional investigations of subjects exposed through crop spraying in non-European countries[18,41]). The associated lack of statistical power may have caused important health effects to go undetected.

Even in larger studies, if the exposure of interest is rare, estimates of morbidity are associated with large confidence intervals. This was the case for accidental injury data in agricultural workers, obtained from the LFS.[17] Because of this, year on year changes in estimates of incidence of reportable injuries from the LFS survey are unlikely to be accurate.

2.12.3 Bias

Bias is a tendency to under- or overestimate a parameter of interest because of a deficiency in the design or execution of a study. Potential sources of bias in the studies reviewed included the selection of participants. For example, most studies focused on farmers currently in work, excluding those who might have left work for health reasons. Also, particularly in studies with small numbers of subjects, it was not always clear how they had been selected, or if they were a representative sample. This applied for example, to the study of field workers who had experienced acute toxicity, by Reidy et al.[41] In others it was clear that the sample was randomly selected from a defined population.[14]

Bias may also occur because of non-response, or through errors in the measurement of exposure or outcome. Response rates in the order of 50% were not unusual in cross-sectional surveys and there was rarely any information on non-responders as was the case in a survey to investigate potential sources of stress.[14] It is possible that those who had symptoms and a history of exposure were more likely to participate, leading to an inflated risk estimate.

Exposure measures

Accurate quantitative and qualitative assessment of exposure was a problem in many studies. Exposures may be especially difficult to characterise if they are intermittent or variable over time.

In studies on the long term effects of OPs, few studies provided information on specific pesticides used, and often non-specific or surrogate measures of exposure were employed - for example job title[65] or tasks undertaken.[60] If used singlly these measures may not have been a reliable index of exposure. More complex indices may provide a better assessment of exposure to sheep dip.[38,47] Direct questioning on amount and type of pesticide used may lead to recall bias, particularly where there is overt concern about health effects of OP pesticides. Biomarkers such as acetylcholinesterase may provide a more reliable index of recent exposure to some specific pesticides but for most pesticides there are no suitable biomarkers for long-term exposures. Blood and urine biomarkers may also be influenced by other factors and so give an inaccurate estimate of exposure.

The precision with which exposure was assessed was also an issue in studies addressing the effect on the back of vibration from tractors. One group found that prolonged sitting and (twisted) posture may influence back pain.[151, 152] Other mechanical factors associated with tractor driving were not investigated in most studies.

Outcome measures

Outcome assessment often varied between studies making it difficult to compare results and sometimes leading to apparently conflicting results. For example, differences in measures to assess depression in farmers may account for discrepancies in estimates of relative risk compared to the general population.[86,90,91]

Several methods have been used to assess health outcome in studies looking at the long-term consequences of acute OP poisoning and at the effects of chronic low dose exposure, including neuro-physiological,[47, 56] and neuropsychological (cognitive) tests[38, 41, 47]. The reproducibility of some tests has been questioned. A quantitative measure used to diagnose peripheral neuropathy, quantitative sensory testing (QST), was developed for use in a clinical setting, but was found to be of limited reproducibility in the field.[51, 73]

If a measured surrogate outcome under- or overestimates a disease, this will often lead to bias.

Observers were not always blinded to exposure status. Subjective or semi-subjective measures such as symptom reporting and speed of completing an intellectual task are prone to observer bias if the researcher is aware of exposure status.

2.12.4 Confounding

Confounding may lead to an over- or underestimate of causal effect. A confounder is associated both with exposure and outcome, is present before the outcome and is an independent risk factor for the outcome. Some studies controlled for potential confounding in the study design by restriction (e.g. limited age group[89]). Others used multivariate analysis.[185,196] Generally, confounding appeared to be adequately controlled, but there were a few exceptions. A number of studies of chronic, low-dose poisoning did not explicitly exclude past acute poisoning.[18, 38, 41, 55, 60] Also, studies that relied on cognitive function as an outcome measure did not always measure or adjust adequately for pre-existing ability.

The investigation of back pain is an example in which many potential confounding variables were measured and often found to be significantly associated with the outcome, though the variables measured varied between studies[139,140, 157-163] Another example is factors contributing to hearing loss.[185, 194-196]

2.12.5 Generalisability to UK farmers

Relatively few of the studies reviewed included UK farmers. Farming practice and the nature of exposure to allergens, toxins and other hazards in some of the countries in which studies were conducted, (such as USA, Equador and India), are quite different from those in the UK because of differences in climate, the size of farms, the nature of farming, crops grown, and socioeconomic factors. Thus it is difficult to know whether findings are transferable to farmers in the UK.

2.13 Summary of need for further research

As discussed in earlier sections it would useful to fill some of the information gaps identified. The following are addressed in this thesis.

- The frequency of adverse symptoms following pesticide use and subsequent morbidity

- The nature of symptoms following pesticide use and whether there is evidence for an acute syndrome specific to sheep dip use (dippers' flu)

- Whether there is evidence for longer term symptoms associated with use of organophosphate pesticides, especially sheep dip, and if there is, whether the nature and frequency of symptoms in OP users suggests a chronic syndrome (such as COPIND)

- The prevalence of mental health problems in agricultural workers

- The frequency and nature of non-fatal accidents occurring during agricultural work and how much accident rates estimated from survey data differ from those reported under RIDDOR.

- The association between agricultural work and musculoskeletal disorders, particularly joint problems other than hip OA.

- The prevalence of respiratory and allergic disorders in British agricultural workers compared to non-farmers and the effect of early farm exposure on asthma and hay fever in adult life.

- The impact of ill health on the ability to work in employed and self-employed agricultural workers compared to those working in other occupations.

CHAPTER 3: DATA COLLECTION AND RESPONSE

3.1 Introduction

As described in chapter 2 the aim of this study was to investigate the relationship of health to pesticide exposure and other aspects of work in agriculture. In order to address this, a large postal survey was used to collect information about work and health from men living in rural areas. Community-based sampling allowed collection of data from men who had worked in agriculture in the past as well as those currently employed in farming. It also enabled comparison with non-agricultural workers and collection of data from those who had not presented or had access to medical care or occupational health services as well as those who had.

3.2 Geographical location

3.2.1 Selection criteria

The main criterion for selecting geographical areas was that there should be a high proportion of men working in agriculture and potentially using OP pesticides, either through sheep farming or crop spraying. On this basis we chose to focus on three regions. These were an area of southern Lincolnshire where OP pesticides had been used widely on brassica crops, and two sheep farming areas, one where there had been much publicity and overt concern about health effects of OPs (Devon), and another where concerns had been less (Welsh Borders: Powys and South Shropshire).

3.2.2 Specification of study areas

Within the regions selected for study to identify electoral wards with a high proportion of men working in agriculture, data from the 1991 Census was used. The Census recorded occupations of a 10% sample of the population at ward level. It also gave the number of economically active males and females (people over 16 working or seeking a job) so that the number and percentage who were farmers or agricultural workers could be estimated for each ward. In all wards the percentage of women recorded as farmers was low (0-2%), so it was decided to include only men in the study.

In the 1991 Census, jobs were classified according to socio-economic groups (S.E.G.s). Farm jobs included S.E.G. 13 (farmers – employers and managers), 14 (farmers – own account) and 15 (agricultural workers). These groups included horticultural and forestry workers. Throughout the remainder of this thesis the terms "farmers" and "agricultural workers" will be used interchangeably and include those who have worked in farm jobs, horticulture and forestry.

In each of the areas selected, ward maps were used to identify contiguous ward groups in which a relatively high proportion of men worked in farming (based on S.E.G. 13 and 14 only, as these were the data available to us at the time). The potential number of subjects within each ward was estimated from the number of economically active men recorded in Census data. The aim was to select approximately 30,000 men (see section 3.2.3). As the number of men aged 25-69 years from the wards initially chosen was much greater than 30,000, for two of the areas (Devon and Welsh Borders), selection was restricted to a subset of wards in which the proportion of male farmers (S.E.G 13 and 14) was 20% or more. In Lincolnshire all wards initially selected were used. The percentage of economically active men who were farmers (S.E.G 13,14 and 15) in 1991 in our selected wards is given in table 3.1.

Table 3.1 Percentage of economically active men who were farmers or agricultural workers* (1991 Census)

Region	**Number of wards included**	**Total Population** (in all wards included)	**Number of farm workers*** (in all wards included)	**Percentage** (% farm workers* in included wards)	**Range** (% farm workers* in individual wards)
Devon	26	12,110	4080	34%	20% - 44%
Welsh Borders	46	12,080	4500	37%	22% -57%
Powys˚	*39*	*10,310*	*3810*	*37%*	*22% -57%*
Shropshire˚	*7*	*1,770*	*690*	*39%*	*24% - 50%*
Lincolnshire	14	6,770	2080	33%	20% -40%

** persons in socio-economic groups 13, 14 and 15*
˚Powys + Shropshire = Welsh Borders

For each of the wards, a list of relevant postcodes was obtained from a data-base held at the Department of Health. The postcodes were used as a means of identifying subjects for inclusion in the study. Subjects resident in Powys and South Shropshire were mailed by different agencies because of health authority boundaries, but the areas were adjacent and were treated as one area (Welsh Borders) in the analyses.

3.2.3 Sample size

Although the study considered many exposures and several groups of outcome measures, sample size calculations were based on questions about the long-term effects of organophosphate pesticides in agricultural workers exposed through use of sheep dip or crop spraying.

From previous experience of postal surveys, in which subjects were sampled from GP registers, a response rate of 55-60% was anticipated. With appropriate definition of the study area, we expected at least 25% of male responders to have worked in farming. A sample of approximately 30,000 men was aimed for in order to achieve a sample of 4000 or more who had worked in farming. It was anticipated that this should be sufficient for us to assess the frequency of even quite rare health outcomes in relation to agriculture. For example, assuming that one third of current and ex-farmers had worked with sheep dip, we would have an 80% power to detect a relative risk of 4.7 for an illness with a prevalence of 1/500 in unexposed persons (at a 5% level of statistical significance).

Other outcome measures to be considered, such as back pain, depression and asthma are more common so smaller relative risks would be detectable under the same assumptions.

3.3 Identification of subjects and mailing

Subjects were identified from data-bases of GP patient registrations. Prior to the NHS re-organisation in England on April 1st 2002, these county-wide data-bases were administered from district health authorities. Since dissolution of the district health authorities, the data-bases have been held either by a Primary Care Trust (PCT) or by separate 'patient services' agencies.

Initially the co-operation of health authorities covering areas of interest was sought but delays in obtaining ethical approval for the study meant that, in England, patients were eventually selected through the new agencies.

An electronic file of postcodes for the selected wards was sent to the relevant agencies and they were asked to identify men, with year of birth 1933 to 1977 inclusive, who were resident in the postcode areas. In June 2002, 35,136 subjects were identified from GP patient lists as meeting the selection criteria.

The agencies allocated each man a serial number and sent us a file giving the serial number, month and year of birth for each man, and the name and address of each GP who had a patient included in the listing. We then wrote to each of the GPs notifying them of the study, and inviting them to contact the agency if they had any male patients in the relevant age range to whom they felt a questionnaire should not be sent e.g. because of recent bereavement or severe illness (appendix 1). Names of patients could not be sent to GPs as we did not have that information, but Dyfed Powys Health Authority wished to include lists of selected patients. Therefore letters for GPs who had patients living in Powys were sent via that Health Authority who enclosed lists of subjects. After receiving information about the study, several practices in Devon requested lists of patients from the Patient Practitioners' Services Agency (PPSA). Therefore the PPSA also chose to send out lists to all practices.

Covering letters from the researchers and agencies helping with the mailing (appendices 2 and 3), questionnaires, and reply paid envelopes were packed in sealed A4 envelopes at the MRC. Each questionnaire and corresponding A4 envelope was marked with a serial number. The participating agencies applied an address label to each envelope (matched by serial number) and mailed the questionnaire. The first mailings took place three to five months after identification of subjects. At this time, patients who were no longer on GP data-bases because they had moved or died, and men whose GPs had requested that they should not be contacted were removed from the mailing list and 34,486 subjects were actually mailed. Figure 3.1 summarises the stages of mailing process.

Figure 3.1 Method used to identify and mail patients without allowing researchers access to personal data

1) SOURCE OF DATA TO IDENTIFY SUBJECTS
Agencies holding GP patient list for each area approached and their co-operation sought.

↓

2) INFORMATION TO SELECT SUBJECTS
Information to identify subjects sent to agencies (age band and full post codes)

↓

3) SUBJECT IDENTIFICATION
Subjects identified from GP database, by agency.
Each allocated a serial number

↓

4) CODED SUBJECT DATA SENT TO MRC
Serial number + month & year of birth sent to MRC by the agency
List of GPs of subjects sent to MRC by the agency

↓

5) GPs INFORMED
GPs (in Devon, Shropshire and Lincolnshire) informed about study by letter from the MRC, and asked to tell agencies if any man in the age range should not be contacted.
For Powys, letters to GPs went via the Health Authority where a list of their patients identified was included.
Names of patients identified later sent to all Devon GPs by the PPSA at the request of some GPs.

↓

6) UNSUITABLE PATIENTS IDENTIFIED
GPs contact agency about unsuitable patients to be excluded from the mailing

↓

7) UNSUITABLE PATIENTS EXCLUDED
Agencies inform MRC of serial numbers to exclude (as advised by GP or no if longer on database)

↓

8) MAILING PREPARED
Envelopes packed at MRC, each marked with serial number of enclosed questionnaire

↓

9) ENVELOPES TRANSPORTED
Sealed envelopes delivered to each agency by van or car

↓

10) ENVELOPES ADDRESSED AND POSTED
Envelopes labelled with name and address (matched by serial number) and posted out from agencies

Figure 3.2 Delivery of questionnaires for mailing

Taking boxes of questionnaires into Dyfed Powys Health Authority

Van full of questionnaires packed in envelopes ready for mailing from Dyfed Powys HA

After an interval, a reminder letter (appendix 4) and questionnaire was sent to those who had not responded. The actual weeks of posting are illustrated in figure 3.3.

Figure 3.3 Timing of mailings in each of the study areas

2002-3	Sept 1	Sept 2	Sept 3	Sept 4	Oct 1	Oct 2	Oct 3	Oct 4	Nov 1	Nov 2	Nov 3	Nov 4	Dec 1	Dec 2	Dec 3	Dec 4	Jan 1	Jan 2	Jan 3	Jan 4	Feb 1	Feb 2	Feb 3	Feb 4	March 1	March 2	March 3	March 4
Devon				■																	░							
Powys		■										░																
Shropshire			■															░										
Lincolnshire												■																░

■ 1st mailing ░ 2nd mailing

In the reminder mailing, only the covering letter from the researchers was included because the assisting agencies had received a lot of calls following the first mailing and did not wish their contact details to be included with the reminder. Following a significant number of calls from people who thought that the study was not relevant to them, the text of the information letter was modified slightly to emphasise that even if people had retired or only recently moved to the area, we would still value their response. The procedure for the second mailing was similar to the first.

Table 3.2 shows the number and percentage of men mailed by area and birth cohort. The age profile of men mailed was similar across each area.

Table 3.2 Number of men mailed by birth cohort and area

Birth cohort	Devon		Welsh Borders		Lincolnshire		Total	
1933-37	1,312	10%	1,312	10%	893	11%	3,517	10%
1938-42	1,558	12%	1,631	12%	941	12%	4,130	12%
1943-47	1,958	15%	1,887	14%	1,219	16%	5,064	15%
1948-52	1,712	13%	1,808	13%	999	13%	4,519	13%
1953-57	1,568	12%	1,579	12%	913	12%	4,060	12%
1958-62	1,530	12%	1,639	12%	948	12%	4,117	12%
1963-67	1,462	11%	1,596	12%	826	11%	3,884	11%
1968-72	1,166	9%	1,182	9%	653	8%	3,001	9%
1973-77	807	6%	935	7%	452	6%	2,194	6%
Total	13,073	100%	13,569	100%	7,844	100%	34,486	100%

3.4 The questionnaire

The questionnaire (appendix 5) was developed in collaboration with colleagues who had experience of designing and using similar sorts of questionnaire.

Among other things, it covered:

- lifetime occupational history and whether jobs involved any of a list of specified activities;
- further details of any work carried out in agriculture, including any use of agrochemicals;
- non-occupational factors that might influence health such as height, weight and smoking habits;
- various aspects of health including musculoskeletal disorders, respiratory complaints and symptoms that have been reported in relation to OPs;
- the impact of more serious illness on capacity to work and use of medical services;
- experience of occupational accidents.

Where possible, sets of questions validated in other questionnaires were used to ascertain health problems. Thus questions from the MRC respiratory questionnaire were used for chronic bronchitis and asthma.[295-297] For asthma a set of nine questions on symptoms, such as wheeze and difficulty breathing in defined circumstances, were used. Venables et al had shown that a positive response to three or more of these questions is a good indicator of self-reported asthma and bronchial hyperesponsiveness.[298] For some conditions, such as angina, a validated set of questions was available but was too long to be used in this study.[136] Therefore a simple question e.g. 'have you ever been told by your doctor that you have had angina or a heart attack?' was used.

I worked in collaboration with a psychiatrist, (RP) who advised on instruments that would allow us to make a more accurate assessment of psychiatric symptoms and take into account personality traits and mental health when assessing reported physical symptoms. The Whitley Index–Dimensions of Hypochondriasis,[299] selected items from the 'Brief Symptom Inventory' (BSI)[300-302] and the Hospital Anxiety Depression (HAD) Scale[303] were included in the questionnaire. The Whitely index is a set of questions devised to tap hypochondriacal attitudes. It has been tested on patients who have been diagnosed as manifesting hypochondriacal features and on controls who showed no evidence of hypochondriasis. Mean scores distinguished the two groups.[299] The sensitivity and specificity of the score have been determined by the cut off score used to identify health anxiety. At a cut off score of 4/5 (five or more positive symptoms taken to indicate health anxiety) the sensitivity had been reported as 87% and specificity 72% on patients classified according to the Stuctured Diagnostic Interview for Hypochondriasis.[304, 305] Mean scores on the Whitley Index have been negatively associated with recovery from unexplained symptoms at one year. [304] The BSI is a psychological self-report symptom scale developed from a longer parent instrument. It has been shown to be reliable and when compared to other similar scales gives evidence of convergent and construct validity.[302, 306] The items selected for use in this study were about somatisation and interpersonal sensitivity. Somatisation is a tendency to experience and communicate physical symptoms in the absence of understandable pathology and interpersonal sensitivity has been shown to be an indicator of low self-esteem. Both the Whitely index and BSI have been used in a community study and found to have high sensitivity compared to general practitioners in identifying patients with medically unexplained physical problems.[301] The HAD scale has been shown to be a reliable instrument for detecting states of depression and anxiety in a hospital setting[303] and has been used in general practice based research and in postal surveys.[86-88] This scale was used in preference to sections of the SF36, for brevity.

Questions relating to demographic details, hearing, back and shoulder pain were taken from questionnaires that had been used successfully in earlier studies.[188, 270] Those on musculoskeletal problems were adapted from the standardised Nordic questionnaire. Self-reported responses to these questions have been compared to those elicited by a physiotherapist in a detailed medical history and a low percentage of disagreement found. In general re-testing reliability was also good.[307] The questions on self-reported hearing loss were similar to those used in a national survey of hearing impairment and disability.[308] Self-reported hearing loss assessed in this way has been validated against measured hearing loss in several studies.[309]

Other questions were designed specifically for this questionnaire in a style we had found was easily understood in previous studies. These included questions on occupational history and exposures. Symptoms that have been associated with exposure to organophosphate pesticides, including those associated with COPIND and dippers' flu, were incorporated into questions that addressed a range of health problems in order to disguise our specific interest. The symptoms of COPIND and dippers' flu are discussed in Chapter 2 (section 2.12).

The questionnaire was piloted on a sample of 60 men registered with a rural Dorset practice to test whether it could be satisfactorily understood and answered. After a single mailing 42% of the sample responded. They completed the questionnaire and an accompanying sheet which asked whether they had any difficulties understanding or answering any of the questions. The majority who responded answered the questionnaire completely and without reported difficulties. There were a few problems understanding parts of the Whitley Index and Brief Symptom Inventory, but as these are validated questionnaires that are frequently used, we decided not to change the wording. A few other minor amendments to the wording of questions in response to the pilot study were made. For example, one man was unsure whether or not he suffered from hay fever so rather than 'do you suffer from hay fever?' we re-worded the question and asked instead 'have you ever been told by a doctor that you have hay fever?' The questions referring to 'hernia/rupture' were clarified to 'hernia i.e. rupture in your groin' because comments from two subjects suggested that they were referring to hiatus hernia when answering the questions.

One problem concerning question 8, which asked if the subject had used certain chemicals in a paid job, was not identified in the pilot study. Three calls were received from self-employed men in Devon, asking whether they should complete the question because they did not regard themselves as having a paid job. I do not know whether many self-employed people took this view. Most of the questionnaires for the reminder mailing had already been printed but we did need an additional batch of 11,000 questionnaires, so in this batch we added '(employed or self-employed)' after 'paid job' in question 8. Most of these amended reminder questionnaires were sent to men in Devon from where queries about this had come.

3.5 Data processing for analysis

3.5.1 Entering and checking data

All data from completed questionnaires were double entered onto a computer and the two sets checked for differences between entries. Any differences were resolved by referring back to the original questionnaire. Duplicate records were identified and the least complete version deleted.

Data were then checked for other queries or inconsistencies within and between questions and for values outside the expected ranges. A checking programme was written for this purpose and the original questionnaires were then reviewed, to look at problems identified. For example, regarding expected range of information, if the amount of alcohol drunk per week was extremely high or the calculated BMI was outside an expected range, or ages recorded for jobs or health problems were 70 or over, these were highlighted as errors and I checked that they had been recorded properly. (Respondents outside the age range were systematically excluded later when questionnaires with reported date of birth different from that of the man mailed were excluded (section 3.7)). Certain items of missing data were identified by the checking programme such as missing ages for starting jobs or where there were question marks in the entered data because, either subjects had written question marks or the information they gave was equivocal and so was not typed in. If the information was missing or unclear it was left as missing. So for example in question 33, (the Whitley Index for hypochondriasis), for some of the items, subjects either put question marks or ticked both 'yes' and 'no'. In these instances where the answer was unclear, it was left blank. Sometimes missing data could be completed from text written on the questionnaire, for example ages could be completed if dates were given or notes written such as '7 years ago'. Where people had written other text for ages such as 'all my life/from birth', 'infancy', or 'as a child', these were completed as ages in a consistent way, i.e. 00, 01, and 7 respectively. For the questions that required a yes/no answer followed by linked questions we checked for consistency within the question or group of questions. So for example if a subject had ticked 'no' or left a stem answer blank, but then gone on to give relevant information later in the question, the stem answer was changed to yes. If the subject had answered yes to a stem question, but not given any further information, the stem was left as yes.

Some further cross checking of data was carried out to look for internal consistency between questions that included similar items. Information about work in farming could be obtained from both question 6 and 10. It was decided to use question 10 to identify people who had worked in farming. This question asked 'have you ever worked in farming, forestry or market gardening?' We expected to identify more jobs from question 10 than question 6, which asked for details of all jobs held longer than a year. Also, question 10 was more often completed than question 6, by men who helped out on family farms and by smallholders.

A total of 4778 men (46.7%) had answered yes to question 10. As a check that not too many farm jobs were missed by focussing on this question, I looked at the occupations of people who had answered 'no' to question 10. There were 41 men whose job description, given in question 6, suggested that they should have answered question 10 positively. We decided that as the number was fairly small we would only use those that had answered question 10 positively to calculate the denominator of those ever and currently working in farming forestry or horticulture.

Not all subjects completed question 10. It seemed that a reason for non-completion might have been that the question was not applicable because they had never worked in farming. This was checked using question 6. Of the 537 who had not completed question 10, 513 had answered question 6, and 59 did appear to have had farming jobs. Therefore, as it appeared that some non-responders to question 10 were farmers, the 537 subjects were not included in analyses of never and ever farmers.

3.5.2 Scoring psychiatric and personality traits

The instruments used to measure hypochondriasis (or health anxiety), somatisation, interpersonal sensitivity, and anxiety and depression have been described in section 3.4. They all measured current state and the scores themselves could not take into account factors that may have affected symptom reporting such as physical disease and disability.

The 14 items used to assess hypochondriasis/health anxiety were in question 33 (appendix 5). Each item was given a score of one for yes and zero for no, except for item i (about being easy to forget yourself and think of other things), which scored the other way round. Thus an individual could score between 0 and 14. Missing data or equivocal answers for any items were given a score of zero for that item. In order to divide subjects into two groups (health anxious or not), it has been recommended to use a cut-off between scores 4 and 5, but other cut-off points have also been used[304]. In our analyses using this score we split subjects into five groups because we had sufficient numbers to do so. The groups were influenced by the skewed distribution of the scores and are given in table 4.6 in chapter 4.

Questions about symptoms that indicated a tendency to somatise were included in question 35 (appendix 5). Subjects were asked to indicate how much problems had distressed or bothered them during the past 7 days. The seven items testing somatisation were a) faintness or dizziness, b) pains in the heart or chest, f) nausea or upset stomach, g) trouble getting your breath, h) hot or cold spells, i) numbness and tingling in parts of your body and j) feeling weak in parts of your body. Each item scored between 0 (not at all) and 4 (extremely). In order to divide subjects up according to tendency to somatise we used a severity index (total score divided by seven). If there were missing data (up to two items), the total scores were used but divided by five or six depending on the number of items completed. Subjects' scores were grouped by selecting cut points that gave reasonable numbers in each category. The cut points used (when assessing acute symptoms in relation to pesticides) are shown in table 4.6 in Chapter 4. The other four items in question 35 measured interpersonal sensitivity and this was scored in a similar way to somatisation. As there were only four items, if more than one item was missing, we did not calculate a score for that subject.

Question 34 in our questionnaire was a reproduction of the HAD scale. The items alternately tapped into anxiety or depression. Thus items a and c etc. were about anxiety and items b and d etc. were about depression. Each item scored 0 to 3, but the direction of scoring varied according to the wording of the question. Scores for anxiety and depression were added separately so that each subject had a score between 0 and 21 for each. Where there were missing data, if no more than two items out of the seven for either depression or anxiety were missing, the value for the missing data was assumed to be the mean value of the other scores in that category. If three or more items were missing out of seven we did not use the data.

In the analyses subjects were grouped into three groups in a predefined way, 0 to 7 (not categorised as anxious or depressed), 8 to 10 (moderate anxiety or depression) and 11 to 21 (severe anxiety or depression).

3.6 Statistical Analysis

All statistical analyses were carried out using STATA software version 8.2 (StataCorp LP, Texas, USA). The methods used to estimate risk were a modified Cox regression method [310], Poisson regression using a person-years approach[311] and conditional logistic regression.

The modified Cox regression approach is a modification of Cox's proportional hazards model which can be used for deriving prevalence ratios (PR) from cross sectional surveys. The 'hazard' (e.g. prevalence of ever reporting a symptom) is measured at one point in time (at the time of the survey). This method was used in chapters 4 and 5 to estimate risk of symptoms in pesticide users and in chapter 7 to assess risk of other symptoms.

Incidence rate ratios (IRR) were derived using a person-years approach and Poisson regression method. Poisson regression was used to estimate the risk ratio of events within discrete time periods (age groups and calendar period). Person years at risk were estimated from ages given in occupational and exposure histories and allocated to discrete time periods. This method was used in chapter 4 (acute effects following pesticide exposure), 6 (accidental injury) and 8 (health related job loss).

Conditional logistic regression was used in chapter 8 to derive odds ratios (OR), in a matched case control analysis nested within a cohort who had provided a sufficient job history.

Each of the chapters 4 to 8, contains a discrete set of analyses and uses different statistical methods, therefore for clarity, the methods used are cited in each chapter prior to the respective results.

Other analytical methods used, such as derivation of observed /expected ratios in relation to multiple symptom reporting in chapter 4 and 5, are also described as a prelude to the relevant results.

3.7 Ethical considerations

Ethical approval for the study was obtained from the South West Multicentre Ethics Committee. Under the 'no local researcher guidelines' all local research ethics committees were informed. The study team did not have access to identifiable information. The only information passed from agencies holding GP databases, to the study team, was serial numbers allocated to individual subjects and corresponding year and month of birth. Questionnaires and letters were addressed and sent out by the agencies holding the patient data, and returned questionnaires were identified only by serial numbers. It was made clear to subjects that whether or not they chose to answer the questionnaire would not in any way affect the care that they received from their doctor.

3.8 Response to questionnaire

3.8.1 Responders and non-responders

Out of the 34,486 questionnaires sent out, 11,001 were returned completed after two mailings (32% of those initially mailed out). As a check that the questionnaire had been completed by the intended recipient, the date of birth on the questionnaire was compared to the year and month of birth against that serial number provided by the health agency. There were 430 mismatches including 236 where the year of birth was inconsistent by more than one digit and more than one year (114 from Devon, 102 from the Welsh Borders and 20 from Lincolnshire). For this latter group, we assumed that the questionnaire had been completed by the wrong person and that the intended recipient never received the questionnaire. In support of this, in some cases it was clear that the respondent was female (17 were identified from job descriptions or other text noted whilst checking questionnaires because of data entry inconsistencies). Also in 27 cases the birth year was outside the sampling range. In those cases where the disparity in date of birth was more minor (only the month was incorrect or year discrepancy was by one digit or one year only), we assumed that the error was in the health authority/agency records and accepted the questionnaire as coming from the correct person. This left 10,765 completed questionnaires (31%

of those initially mailed out). Of the remainder, a reason for non-completion of the questionnaire was identified for 6%. Table 3.3 summarises the overall outcome of the mailing.

Table 3.3 Responders and non-responders

Response or Reason for non-response	Frequency	
Returned by Royal Mail	1,277	3.7%
Too ill or died	51	0.2%
Moved/died between 1^{st} and 2^{nd} mailing	548	1.6%
Wrong person answered questionnaire	236	0.7%
Objected to completing questionnaire	60	0.2%
No reply for other identified reason	22	0.1%
No reply – reason not identified	21,527	62.6%
Response without re-mailing	7,810	22.7%
Response with re-mailing	2,955	8.3%
Total	34,486	100%

3.8.2 Response by area and birth cohort

After exclusion of subjects who we knew did not receive the questionnaire or were unable to complete it for health reasons, the overall response rate was 33%. Table 3.4 illustrates the response by birth cohort and area and gives the crude response rate, based on all those mailed, and adjusted response rate, after excluding those from the denominator who could not respond. There was a clear age trend in the response rate, which was similar for each area, with a higher response in older men.

The same pattern of response was evident from each of the first and second mailings. From the first mailing, the overall adjusted response rate was 24%, with a decreasing trend from the oldest age cohort (33%) to the youngest (12%), and for the repeat mailing the corresponding response rates were 9% (12% to 6%). The response rate was similar across all areas.

Table 3.4 Response by birth cohort and area

Birth cohort	Devon			Welsh Borders			Lincolnshire			Total		
	n	%[c]	%[a]	n	%[c]	%[a]	n	%[c]	%[a]	n	%[c]	%[a]
1933-37	572	43%	45%	590	44%	46%	361	40%	45%	1,523	43%	45%
1938-42	646	41%	43%	685	42%	43%	387	41%	45%	1,718	42%	43%
1943-47	709	36%	38%	705	37%	39%	436	36%	40%	1,850	37%	38%
1948-52	566	33%	34%	608	34%	35%	291	29%	32%	1,465	32%	34%
1953-57	463	30%	31%	517	33%	33%	270	29%	34%	1,250	31%	32%
1958-62	385	25%	26%	462	28%	29%	242	26%	30%	1,089	26%	28%
1963-67	345	23%	25%	425	27%	28%	169	20%	24%	939	24%	26%
1968-72	225	19%	21%	239	20%	21%	118	18%	22%	582	19%	21%
1973-77	131	16%	18%	163	17%	19%	55	12%	16%	349	16%	18%
Total	4,042	31%	32%	4,394	32%	33%	2,329	30%	34%	10,765	31%	33%

%[c] - crude response rate based on all those mailed
%[a] – adjusted response rate after exclusion of those who had not received questionnaire because of wrong address, or who had died or were too ill to respond.

3.8.3 Response from farmers

Several phone calls were received from men who were hesitant about responding because they did not work in typically rural occupations and thought that their answers would not we useful. Therefore we decided to assess whether people working in agriculture were preferentially responding. In order to check if the response rate was importantly different in men who worked in agriculture compared to other occupations, the response rate was estimated for men who had worked in agriculture at the time of the 1991 Census.

First, an estimate was made of the number of men mailed who were aged 16 or more at the 1991 Census (economically active age) and who worked in farming or agriculture. Then the number of men in farming jobs in 1991 among responders was estimated. To do this, the jobs that each man was doing around the Census date, (21st April 1991) were identified by taking any job that had started at or before their age on the Census date and finished after their age on the Census date. If men indicated that they did more than one job e.g. farmer and lorry driver, they were classified as part-time farmers. It is not clear how many jobs we classified as part-time would have been included as farmers/agricultural workers in the Census. We therefore calculated two estimates of response rate among farmers, one that included anyone who worked in farming at the approximate time of the Census, and one that included only full-time farmers and agricultural workers.

The estimated response rate from men who were farmers in 1991 is shown in table 3.5. The estimated crude response rate from men working in farming at that time was 19% (21% if part-time farmers were included) which was lower than the crude response rate of 31% for the total sample.

Table 3.5 Estimated number of men in study sample working as farmers or agricultural workers at the 1991 Census (who were born after 21st April 1975)

	Devon	Welsh Borders	Lincolnshire	Total
Proportion of men in area who were working in agriculture at the 1991 Census	34%	37%	33%	
Number of men mailed who were 16+ at Census date	12 730	13 141	7638	33 509
Estimated number of men mailed who were farmers in 1991	4328	4862	2521	11 711
Number of responders who worked full time in agriculture at their birthday following the 1991 Census	811	988	443	2242
Estimated response rate (full time farmers/farm workers)	18.7%	20.3%	17.6%	19.1%
Number of responders who worked in agriculture (full or part time) at their birthday following the 1991 Census	897	1087	465	2449
Estimated response rate (full time farmers/farm workers)	20.7%	22.4%	18.4%	20.9%

3.9 Characteristics of responders

3.9.1 Proportion in farming

The proportion of responders who had ever worked in farming was 46.7% (4742 men). Over half of these (53.3%) had been self-employed and a majority (56.8% - 2691 men) were working in an agricultural job at the time they completed the questionnaire.

3.9.2 Characteristics of responders

Various characteristics of responders according to whether they worked in agriculture are shown in figures 3.4 to 3.7. There were a higher proportion of men under 40 years in the employed, current agricultural workers, than in other groups and fewer in the older age group (55+) shown in figure 3.4. The relatively high frequency of older men among never farmers could reflect responses from men moving into the area to retire. Most men were married (70-80% in all groups). A higher proportion of men were single in the group who were currently employed as agricultural workers compared with self-employed and never farmers (figure 3.5). This could reflect the relatively high proportion in the younger age group.

Figure 3.4 Year of birth distribution in sample

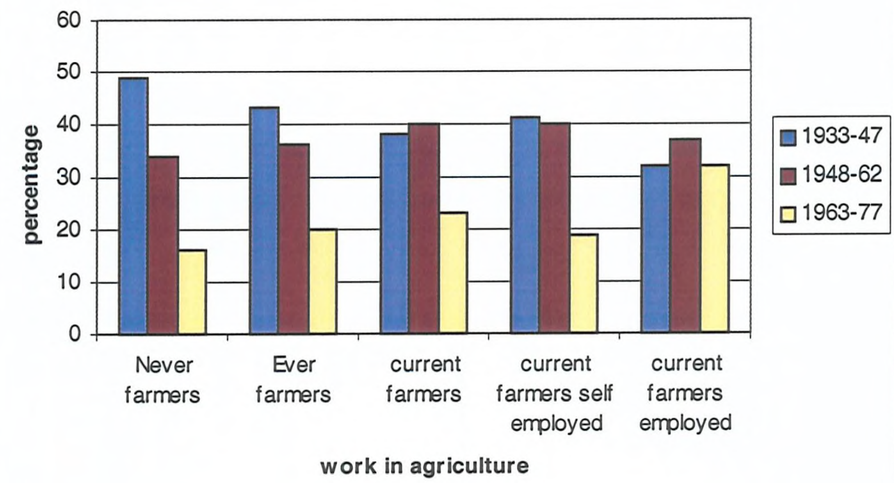


Figure 3.5 Marital status in sample

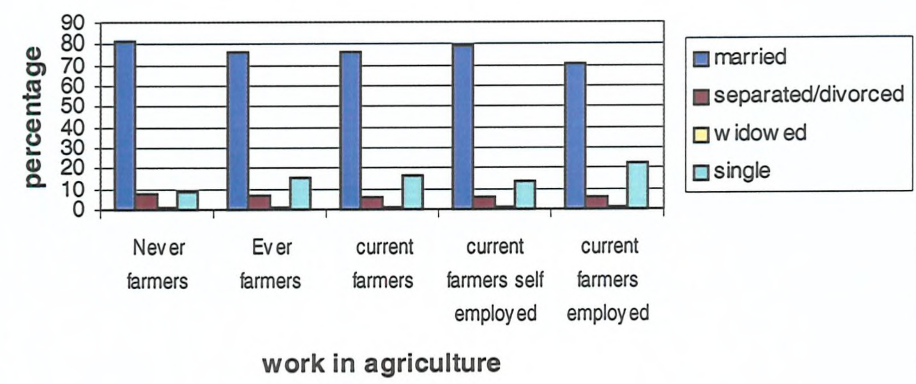
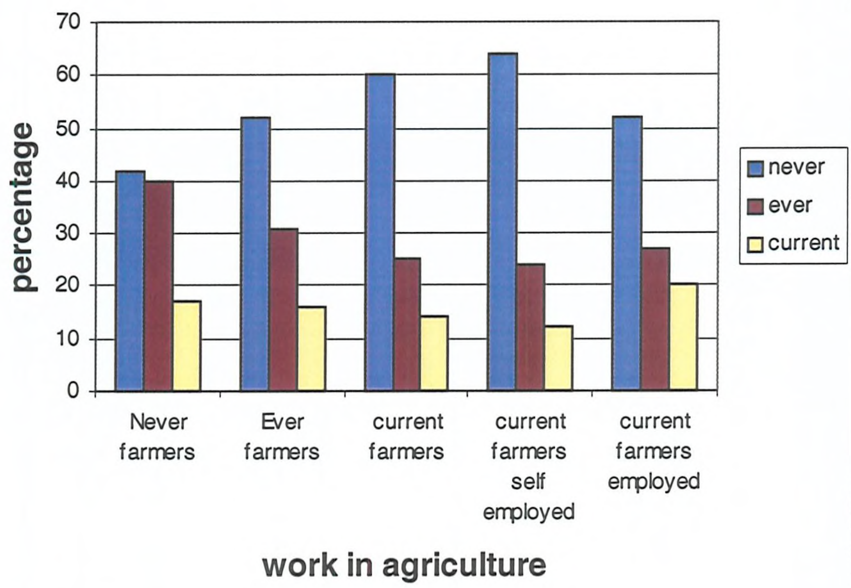
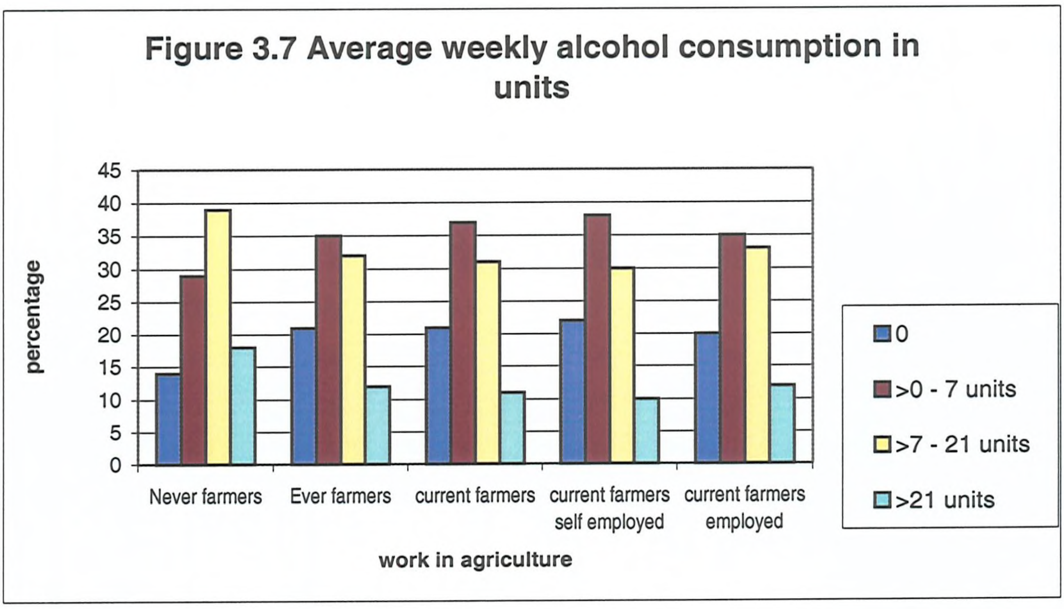


Figure 3.6 illustrates smoking status. Current farmers smoked less than never or ever farmers. This was attributable to relatively little smoking among self-employed farmers as the highest proportion of current smokers was among employed agricultural workers. It appeared that if farmers ever smoked they were less likely to have stopped than never farmers, especially farm employees. Differences in age distribution in the respective groups may partly explain patterns smoking status. Men who had worked in farming were more likely to be moderate or non-drinkers than never farmers, particularly self-employed farmers. (figure 3.7) The median height and Body Mass Index (BMI) and distribution of these measures were similar in all groups.

Figure 3.6 Smoking status in sample





3.10 Additional Mailings

In order to address some of the issues over potential response bias associated with the low response, we carried out two subsidiary studies. Each of these received ethical approval from the South West MREC

In the first, a short (2 sided) questionnaire (appendix 6) was sent to a random sample of 300 non-responders from each of the three regions, Devon, Welsh Borders and Lincolnshire. The short questionnaires were mailed out in a similar manner to the previous questionnaires. The aim of this was to derive critical prevalence and risk estimates from a random sample of non-responders, and then compare these estimates with those obtained in the main study.

The questionnaires were sent out at the end of May 2003, with an accompanying letter (appendix 7). One person in Powys had come off the GP patient database between identification and mailing so 899 questionnaires were sent out (300 from Devon, 299 from the Welsh Borders (249 from Powys, 50 from South Shropshire) and 300 from Lincolnshire).

We received 109 completed questionnaires (12% response), and had information on a further 22: sixteen were returned by Royal Mail, two could not complete because of disability and four objected. The response was similar from each area (13% from Devon, 11% from the Welsh Borders (10% Powys, 14% Shropshire) and 13% from

Lincolnshire). The number of responses received was not sufficient to use for comparison of prevalence and risk estimates with responders to the main study, therefore no detailed analysis was performed on responses to the short questionnaire.

In the second subsidiary study assistance was sought from three GP practices adjacent to areas covered in the main study, in Somerset, Carmarthenshire and South Lincolnshire. They were asked to mail the 16 page questionnaire (appendix 5) and our covering letter (appendix 8) to a sample of men on their lists, each with a personalised letter from the Practice (appendix 9). The aim was to assess whether personalised mailing from general practitioners achieves a better response than mailing from larger, local NHS organisations, and if a higher response was obtained, to look further at the potential for response bias in the main study.

After ethical approval was granted the general practices identified men on their list born between 1933 and 1977. In the practice in Wiveliscombe, Somerset, 380 men were identified and all were mailed. The Llandeilo practice in Carmarthenshire identified over 2000 patients meeting the criteria and selected 300 men by random sampling. The practice in Holbeach, Lincolnshire selected 299 men by systematic sampling from their list. Each practice provided us with a list of dates of birth and the corresponding patient numbers of subjects selected. Packed and stamped envelopes (including questionnaire, stamped addresses envelope and letter from the MRC) were delivered to each practice at the end of October 2003. Both the outside of the envelope and the questionnaires were marked with a serial number as in the main study. The practices produced a personalised covering letter for each patient from the general practitioners and put the letter into the corresponding envelope (matched by patient number) and posted the envelopes. The Welsh packets contained Welsh and English translations of the questionnaire and letters. The letters were posted between the end of October and 11^{th} November 2003.

In total we received 334 completed questionnaires (34%) and in addition, were told about four men who had moved away by the Carmarthenshire Practice. The number of completed questionnaires and response rates for each area were as follows: Carmarthenshire 89 (30%), Lincolnshire 104 (35%) and Somerset 141 (37%). These response rates are discussed in the following sections.

3.11 Discussion

3.11.1 Selection of areas

The choice of sheep farming areas included in the study was determined by density of farming, differences in degree of overt publicity about OP pesticides, distance from our research base in Southampton, and agreement by Caldicott guardians of the district health authorities and new agencies to participate. Therefore for practical reasons, areas in the North of England or Scotland were not chosen. We had hoped to include areas in the Peak District (parts of Staffordshire and Derbyshire) but following organisational change, there was confusion over responsibilities and/or manpower difficulties so they were unable to participate. The estimated total eligible population in these areas was relatively small, (3040 subjects).

3.11.2 Method of patient identification and selection

A community sample rather than an occupational sample was chosen so that both current and ex-farm workers would be included. This mode of sampling also allowed collection of information from men working in other occupations so that a broader range of questions on health and work in rural communities could be considered. The method also allowed inclusion of people not in work because of poor health.

Even if we had chosen to select by current occupation, the available sources of information, such as listings of members of the NFU or farms listed in the Yellow Pages, would not have included all agricultural workers in a selected area, whereas a community sample should do so. Also by informing subjects that we were interested in responses from all men, and including questions on other work, it was hoped that the emphasis on health problems associated with farming would be disguised to some extent.

Our reason for not including women was that their prevalence of exposure to the occupational activities of main interest would be much lower than for men, and that would make the study less efficient statistically.

Having decided to use a community sample, the options for a reasonably representative sample were to use GP patient registration lists or the electoral roll.

The electoral roll includes only those eligible to vote i.e. British, Irish, EU and commonwealth citizens over the age of 18, but not, foreign nationals. It is collated by local authorities. I had used this source of data previously, but found the response was low. Part of the reason for this was that addresses were out of date. This problem could have been minimised by approaching local authorities in February, when information would have been only 6 months out of date. Country-wide data were also available from commercial companies who purchased electoral rolls from individual local authorities each year. However, processing time meant that their data were 9 – 20 months out of date.

It was not possible to select by age using the electoral roll and identification of sex was generally based on title, so men who used a title other than Mr may have been missed. Commercial companies could select by postcode but the cost was greatly increased if full postcodes needed to be used, as in this study. Furthermore, since 2003 only an edited version of the electoral roll has been available for purchase. This excludes anyone who ticked a box on their electoral roll form to indicate that they did not wish to be included in the version publicly available.

GP registration data had been used by other researchers in the MRC Unit for community studies.[270, 312, 313] While there are problems with GP lists not being completely up to date, our experience following selection by this method, suggested that response rates are higher than those from electoral roll mailings. GP registration data also allow selection by age or year of birth.

At the time of setting up the study, views on data protection meant that it was no longer possible to receive names and addresses of patients, nor did we have ethical approval to approach them directly by sending them a questionnaire. This meant that the agencies holding the data-bases had to be asked to identify subjects and do the mailing for us. I initially sought the co-operation of GPs in this, but their response was disappointing, and therefore approached district health authorities who kept all GP patient lists on a single database. These larger agencies had more capacity to assist in patient selection and to take on extra staff to label the envelopes that I delivered to them.

3.11.3 The questionnaire

A prime reason for the study was to look for evidence of long-term effects of low level exposure to OP pesticides. The questionnaire therefore included detailed exposure and outcome questions relating to this. Questions on other exposures and outcomes, to some extent, were there to disguise this purpose of the questionnaire, thus possibly reducing response and recall bias. However the questions on other topics were useful in their own right and provided information on health effects associated with various occupational exposures. Because there had to be a balance between brevity and detail, the questionnaire did not ask about all factors that might be important in the aetiology of many of the health outcomes. In some instances these had been studied already in more detail but in other populations that included relatively few farmers e.g. hand-arm vibration syndrome[270]and back pain.[314] This study gave us the opportunity to gather additional information about these conditions in people working in agriculture.

3.12 Possible reasons for low response

We had hoped for a higher response rate in this study, based on previous experience. In a similar type of community mailing from the MRC (conducted via GPs to over 22,000 subjects aged 16 to 64 years) the response rate from women was 69% and the rate from men was 55%. In that study the response was better from more rural areas, the response rate from Devon being almost 75% whereas it was only 39% from Lambeth.[315]

There were several possible reasons for the low response in the current study. One was that subjects were incorrectly identified. Addresses on General Practitioner lists were not completely accurate. Individuals who had moved away were only removed from the list if they registered with another GP, and a few people who had died seemed to remain on GP lists. However, these probably only accounted for a minority of non-responders. It was unlikely that the GP lists used on our behalf were more inaccurate than GP lists accessed for other studies that had achieved a better response rate.

Also this study included only men and in other studies the response from men has generally been poorer than from women.[315]

Some subjects may have thought the questionnaire was not relevant to them. The covering letter did say "we very much hope that you will be willing to help us, even if some parts of the questionnaire do not apply to you". This was further emphasised and highlighted in the reminder letter by specifying in bold that it did not matter if people had recently moved to the area or retired. This phrase was added following telephone calls from men who had recently moved to the area, retired, or never worked in farming, who thought that their information might not be useful. However even though some non-farmers thought that the questionnaire was irrelevant, the estimated response rate from farmers was even lower than the overall response rate. The lower response from farmers may have been because farmers were too busy or thought that they already had enough paperwork. Whatever the reason, as farmers made up a large proportion of the selected population, the low response rate in this group would have contributed to the overall low response rate.

The questionnaire was fairly long but this may not have been an important deterrent. A longer questionnaire was used in a similar type of study in 1997 to 1998 and a response rate of 61% achieved.[270] However, the fact that the third mailing of a shorter questionnaire in the subsidiary study, described in section 3.9, had a better response rate than the second mailing of the long questionnaire, in the main study, does suggest that the length of the questionnaire may have been a factor.

Anecdotally, it seems that people are becoming less willing to complete questionnaires than they have been in the past. A reason for this may be the general volume of uninvited mail received by many. Also the apparent ease of access to personal data by commercial companies can only serve to increase individuals' concern over data protection.

Another reason why subjects may have been less inclined to respond is because of the method we were required to use for mailing. The mailing came from NHS agencies that individuals may not have heard of and included an impersonal letter, beginning 'Dear Sir'. Previous experience of GPs mailing on our behalf to named patients resulted in better response rates. Using the 'Health and Work in Rural Communities' questionnaire, the response rate to a single mailing via general practices was 34% compared with 23% from health agencies. This was still less than response to the pilot for this study (42%) and for other similar types of studies, but did suggest that involvement of general practitioners in contacting patients helped to improve the response rate.

It was possible that response may have been influenced by when subjects received their questionnaires. We would have preferred the first and second mailings to take place during mid- September and early November 2002, thus avoiding the busy times in the agricultural calendar and holiday periods. Because of the complex method of posting that we were required to use, the timing was partly determined by the agencies assisting us, as illustrated in figure 3.3, so not quite as we planned.

Despite the low response we have still collected sufficient data to analyse and provide us with useful information although care was needed in interpretation of the findings.

The following chapters used data from the questionnaire to address specific questions concerning work and health.

CHAPTER 4:
ACUTE HEALTH EFFECTS ASSOCIATED WITH PESTICIDE EXPOSURE AT WORK

4.1 Introduction

As discussed in chapter 2, there is clear evidence that exposure to OP insecticides and other pesticides can result in acute adverse effects. While hospital admission for unintentional acute pesticide poisoning is rare, anecdotal reports suggest that less serious illness following work with pesticides is more common. However, the frequency of adverse effects is unclear and it is not known to what extent direct toxicity and psychological mechanisms contribute to symptoms.

As part of this study the association between pesticide exposure at work and acute symptoms following that exposure was investigated. Also, whether certain subgroups of individuals, in relation to geographical area and personality characteristics, were more likely to report symptoms was explored as were temporal patterns of symptom reporting and the effect of reported symptoms on ability to continue working.

4.2 Exposure to pesticides in an agricultural job

The analyses in this chapter are on men who reported using pesticides at work and had at some time worked in agriculture (farming, forestry or market gardening). An assumption was made that most men who had held an agricultural job and reported occupational pesticide use would have used pesticides in their agricultural job. In these subjects, the time periods spent in agricultural jobs, ages given for starting and stopping pesticide use and the nature of other types of jobs held suggested that this was a reasonable assumption to make. Of the men who reported any pesticide use at work, 20% had never worked in an agricultural job. These were not included in the analyses.

In order to ascertain pesticide exposure we asked subjects if they had ever worked, in a paid job, with herbicides, fungicides, insecticides, sheep dip or wood preservative. Of the 4778 men who reported ever working in agriculture (farming forestry or horticulture), 3275 (69%) indicated that they had used at least one specific type of pesticide in a paid job.

Among agricultural workers exposed to pesticides at work, 79% had used herbicides, 49% fungicides, 56% insecticides, 63% sheep dip and 46% wood preservatives (table 4.1). There was some variation by region, consistent with the nature of farming. In particular, men in Lincolnshire were less likely to have used sheep dip and more likely to have used insecticides and fungicides compared to the other two areas.

Table 4.1 Pesticide use by area in men who had ever worked in agriculture

Pesticide type	Devon n (%)	Welsh Borders n (%)	Lincolnshire n (%)	All areas n (%)
Herbicides	996 (80%)	1004 (74%)	596 (90%)	2586 (79%)
Fungicides	640 (51%)	450 (33%)	500 (76%)	1590 (49%)
Insecticides	713 (57%)	577 (42%)	541 (82%)	1831 (56%)
Sheep Dip	790 (63%)	1064 (78%)	221 (33%)	2075 (63%)
Wood preservatives	629 (50%)	625 (46%)	264 (40%)	1518 (46%)
Any of 5 types	1250 (100%)	1364 (100%)	661 (100%)	3275 (100%)

Multiple chemical use was frequent, 36% of men having used four or all five of the chemical types listed and 43% having used two or three. The age range for reported start of using pesticides was wide. Start ages were from 'birth' to 65 years. However as we were only considering pesticide use at work, for relevant analyses we allocated a start age of 14 years to men who reported using pesticides below that age.

Approximately one third (31%) of ever users of sheep dip were still using it at the time they completed the questionnaire and for other chemicals the figure was between 47% and 58% (Table 4.2). (Current users were defined as those still using the chemical at calculated current age or current age minus one to takr into account the seasonal nature of pesticide use).

Table 4.2 Patterns of use of chemicals men who had ever worked in agriculture

Pesticide type	Lifetime use in days <10 days n (%)	10-49 days n (%)	>50 days n (%)	Used concentrate n (%)	Current users n (%)
Herbicides	449 (18%)	825 (33%)	1227 (49%)	2212 (86%)	1302 (50%)
Fungicides	248 (16%)	404 (27%)	857 (57%)	1234 (78%)	743 (47%)
Insecticides	283 (16%)	520 (30%)	935 (54%)	1381 (75%)	869 (47%)
Sheep Dip	453 (23%)	752 (38%)	752 (38%)	1488 (72%)	652 (31%)
Wood preservatives	367 (26%)	496 (35%)	564 (40%)	424 (28%)	875 (58%)
Any type					2898 (88%)

The amount of sheep dip use was quite similar in Devon and Lincolnshire, though higher in the Welsh Borders. In Devon and Lincolnshire respectively 30% and 31% of users used sheep dip less than 10 days and 31% and 36% had used it for 50 days or more. (The respective proportions in the Welsh Borders were 17% and 45%) The proportion that had used sheep dip concentrate was 64% in Devon, 65% in Lincolnshire, and 78% in the Welsh Borders.

4.3 Frequency of acute symptoms

The data presented here on acute symptoms following use of specific types of pesticide is restricted to those who reported using either herbicides, fungicides, insecticides, sheep dip or wood preservatives in a paid job and who indicated that at some time they had worked in farming, forestry or market gardening. 143 men who indicated that they had had symptoms but not used pesticides at work were not included in analyses.

Symptoms were not uncommon after using pesticides. When asked if they had ever suffered from any of the symptoms, listed in table 4.3, within 48 hours of using a pesticide or sheep dip, of the 3275 men who indicated that they had worked with one or more of herbicides, fungicides, sheep dip, insecticides and /or wood preservatives, 879 (27%) reported one or more symptoms in relation to one or more of these pesticides.

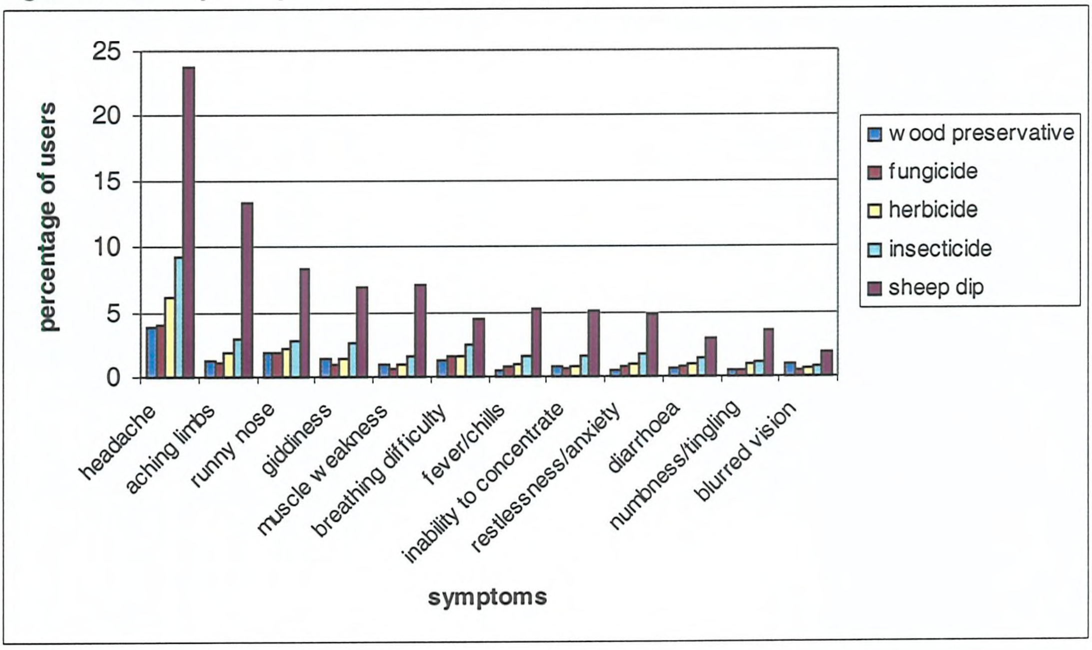
The numbers and proportions of men who reported symptoms within 48 hours, and the types of pesticides for which symptoms were reported, are given in table 4.3. Symptoms were most commonly reported following use of sheep dip: 29.4% of sheep dip users complained of at least one of the listed symptoms within 48 hours of using sheep dip. The corresponding figure was 12.3% for users of other insecticides, and between 6.0% and 8.2% for other pesticide types. The pattern of symptoms reported was similar for each pesticide type, headache being the most frequent symptom reported following use of each and any pesticide type (figure 4.1).

Table 4.3 Frequency and proportion of pesticide users who experienced symptoms within 48 hours of use of a specific pesticide type

Symptom	Herbicide (n=2586)	Fungicide (n=1590)	Insecticide (n=1831)	Wood preservative (n=1518)	Sheep dip (n=2074)	Any of 5 (n=3275)
Headache	159 (6.1%)	63 (4.0%)	169 (9.2%)	59 (3.9%)	490 (23.6 %)	704 (21.5%)
Aching Limbs	48 (1.9%)	18(1.1%)	53 (2.9%)	19 (1.3%)	273 (13.2%)	332 (10.1%)
Runny nose	57 (2.2%)	28 (1.8%)	51 (2.8%)	27 (1.8%)	172 (8.3%)	249 (7.6%)
Giddiness	35 (1.4%)	15 (0.9%)	48 (2.6%)	21 (1.4%)	143 (6.9%)	201 (6.1%)
Muscle weakness	26 (1.0%)	10 (0.6%)	27 (1.5%)	14 (0.9%)	147 (7.1%)	174 (5.3%)
Difficulty breathing	38 (1.5%)	26 (1.6%)	46 (2.5%)	20 (1.3%)	91 (4.4%)	164 (5.0%)
Fever or Chills	27 (1.0%)	12 (0.8%)	27 (1.5%)	6 (0.4%)	111 (5.3%)	138 (4.2%)
Inability to concentrate	21 (0.8%)	10 (0.6%)	29 (1.6%)	11 (0.7%)	106 (5.1%)	134 (4.1%)
Restlessness or anxiety	26 (1.0%)	11 (0.7%)	31 (1.7%)	8 (0.5%)	100 (4.8%)	130 (4.0%)
Diarrhoea	23 (0.9%)	13 (0.8%)	25 (1.4%)	9 (0.6%)	61 (2.9%)	99 (3.0%)
Numbness or tingling > 3 mins	22 (0.9%)	6 (0.4%)	20 (1.1%)	7 (0.5%)	72 (3.5%)	96 (2.9%)
Blurred vision	15 (0.6%)	7 (0.4%)	13 (0.7%)	13 (0.9%)	39 (1.9%)	61 (1.9%)
Any symptom	212 (8.2%)	95 (6.0%)	226 (12.3%)	91 (6.0%)	609 (29.4%)	879 (26.8%)

n = number of users

Figure 4.1 Frequency of individual symptoms in relation to each pesticide type



In order to assess the possibility that those who had experienced symptoms were more likely to respond to the questionnaire, we looked at the frequency of reported symptoms in early responders compared to those who had been sent a reminder. In the main study the proportion of pesticide users who reported at least one symptom in relation to any of the five pesticide types was 27.9% in early responders (2333 men who had ever worked in agriculture) and 24.1% in those who had been re-mailed (941 men). Among the 108 ever-agricultural workers responding to the GP study (all first time responders), 24.1% of pesticide users reported at least one symptom. Between the early and later responder groups in the main study, the absolute difference in reporting any symptom in relation to an individual pesticide type varied between 0.8% and 3.1%, and was higher in the early responder group for all pesticide types except wood preservatives. The pattern of symptoms reported was similar for both groups, mirroring the overall frequencies shown in figure 4.1.

4.4 Multiple symptom reporting

In order to assess whether multiple symptom reporting by individuals was more frequent than would be expected if symptoms were reported independently of each other, we calculated observed/expected ratios. The observed figures were the number of subjects reporting each number of symptoms (0 to 12). In order to calculate the expected values, for each pesticide type (and any pesticide) the probability of reporting (and not reporting) each individual symptom was calculated from observed numbers. The probability of reporting each combination of zero to 12 symptoms was then calculated with the assumption that reporting of each individual symptom was statistically independent. For each number of symptoms the sum of probabilities for each combination making up that number gave the expected probability of reporting that number of symptoms. By multiplying probabilities by the number of pesticide users, the expected number of subjects suffering from each number of symptoms was then calculated.

We found that multiple symptom reporting by the same subjects was more frequent than expected. The observed/ expected ratio for reporting four or more symptoms in relation to any pesticide type was 17.2 ($p<0.001$) and the frequency of reporting one or two symptoms was less than expected. (table 4.4) The excess of multiple symptom reporting applied to all pesticides, but was highest in users of sheep dip.

Table 4.4 Multiple symptom reporting to any pesticide

Number of Symptoms	Observed (O)	Expected (E)	O/E
0	2396	1469	1.6
1	303	1251	0.2
2	239	450	0.5
3	107	92	1.2
4+	230	13	17.2

We examined pairwise association between symptoms by calculation of odds ratios (ORs). Certain symptoms did appear to cluster. In relation to any pesticide type, muscle weakness, aching limbs and inability to concentrate were all strongly associated with each other (OR 11.7-16.7). Inability to concentrate was also strongly associated with blurred vision (OR 14.7) and restlessness or anxiety (OR 18.9). Blurred vision was moderately associated with all other symptoms except headache, and restlessness and anxiety showed a similar pattern of association. Thus the symptoms that clustered most appeared to be muscle weakness, aching limbs and inability to concentrate, blurred vision and restlessness.

Although headache was the most frequent symptom complained of by single and multiple symptom reporters, this symptom was only weakly associated with other symptoms.

The pattern of multiple symptom reporting was similar when different pesticide types were considered individually. It was noteworthy that for sheep dip there was a relatively weak association between pairs of 'flu-like symptoms, (runny nose, headache, aching limbs, fever or chills and giddiness) OR 0.7 to 4.3. Also the pattern of association of these symptoms was no different from that which occurred for other types of pesticide, except for herbicides where there was a stronger association between fever or chills and aching limbs (OR 11.9).

4.5 Symptoms in relation to several pesticide types

Some subjects reported symptoms in relation to more than one type of pesticide that they had used. In order to assess whether reporting symptoms in relation to one type of pesticide influenced the probability of symptom reporting following use of other pesticide types, expected values were calculated for reporting any symptoms in relation to 0,1,2,3,4,or 5 pesticide categories. For each class of pesticide, the proportion of exposed workers with one or more symptoms gave an estimate of the probability of symptoms in relation to exposure. With the assumption that the probabilities were independent (i.e. reporting symptoms in relation to one type of pesticide did not affect the probability of reporting symptoms with any other pesticide category), we then calculated the probability of reporting symptoms in relation to each possible combination 0,1,2,3,4 and 5 pesticide types according to the types of pesticide with which a subject had worked. These probabilities were applied to the number of subjects who had worked with each combination of pesticide types and the results summed to derive the total expected number of men in the sample with symptoms relating to each number of pesticide types.

The tendency to report symptoms in relation to more than one pesticide category was much higher than expected. The observed/expected ratios are shown in table 4.5

Table 4.5 Reporting of symptoms to more than one chemical category – observed and expected frequencies

Number of Chemicals	Observed frequency (O)	Expected frequency (E)	O/E
0	2396	2544	0.9
1	628	669	0.9
2	153	59	2.6
3	57	3	21.5
4	29	0.06	509.1
5	12	0.0005	26674.5

4.6 Association with personal characteristics

Prevalence ratios were calculated for those with at least one symptom in relation to a chemical class compared to those with no acute symptoms to that chemical class for birth cohorts in five year bands, ever smoking compared to never, average weekly alcohol consumption levels, and levels of anxiety, depression, somatising tendency, interpersonal sensitivity (IPS) and health anxiety. These were all the variables considered to be potentially relevant and on which I had information. Measurement and scoring of the latter traits have been described in chapter 3. The first column in table 4.6 shows how scores were categorised for use in the analysis. The division of scores for somatising tendency, IPS and Whitley index was based on the overall distribution of scores in the users of pesticides. Scores for anxiety and depression were used using *a priori* cut points from the literature to indicate low, moderate and severe anxiety or depression. A modified Cox regression analysis was used to calculate the mutually adjusted prevalence ratios (PRs).[310]

Table 4.6 Association between acute symptoms in relation to any pesticide and personal characteristics (n=3197)

Risk factor	Number with symptoms *	PR (95%CI)
Birth cohort		
1933-37	328	0.6 (0.5-0.9)
1938-42	461	0.9 (0.7-1.2)
1943-47	483	1.0 (0.8-1.3)
1948-52	419	1.1 (0.8-1.4)
1953-57	411	1.0 (0.8-1.3)
1958-62	391	1.0 (0.7-1.3)
1963-67	349	1.0 (0.8-1.3)
1968-77	355	1.0 -
Smoking Habit		
Never	1713	1.0 -
Ever	1484	0.8 (0.7-0.9)
Average weekly alcohol		
None	644	1.0 -
1-7 units	1182	1.1 (0.9-1.3)
8-21 units	988	0.9 (0.8-1.1)
>21 units	383	0.9 (0.7-1.2)
Anxiety		
Low (0-7)	2484	1.0 -
Moderate (8-10)	433	1.1 (0.9-1.3)
Severe (11-21)	280	1.1 (0.9-1.5)
Depression		
Low (0-7)	2766	1.0 -
Moderate (8-10)	285	1.1 (0.8-1.3)
Severe (11-21)	146	1.2 (0.9-1.6)
Somatising tendency		
0 (lowest)	1043	1.0 -
0.1-0.5	1266	1.4 (1.2-1.7)
0.6-1.0	571	1.6 (1.2-1.9)
>1.0	317	2.0 (1.6-2.6)
Interpersonal sensitivity		
0 (lowest)	1403	1.0 -
0.1-0.5	869	1.1 (1.-1.4)
0.6-1.0	461	1.2 (1.0-1.5)
>1.0	464	1.1 (0.8-1.3)
Whitley Index		
0 (lowest)	708	1.0 -
1	906	1.2 (0.9-1.5)
2	573	1.2 (1.0-1.5)
3&4	551	1.2 (1.0-1.5)
5+	459	1.2 (0.9-1.5)

*Numbers used to calculate PRs restricted to those providing full information
All PRs are mutually adjusted

No clear trend in risk was observed in relation to interpersonal sensitivity or Whitely Index, and these variables were omitted from subsequent analyses. In contrast, however, those with highest somatising tendency scores were significantly more likely to report at least one symptom in relation to any type of pesticide. This association was apparent for each individual pesticide type (table 4.7).

Table 4.7 Association between acute symptoms and somatising tendency

	Herbicides n=2535		Fungicides n=1567		Insecticides n=1798		Wood Preservatives n=1493		Sheep Dip n=2023	
Somatising tendency Score	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)
0 (lowest)	812	1.0 -	479	1.0 -	557	1.0 -	456	1.0 -	654	1.0 -
0.1 -0.5	1022	1.5 (1.0-2.2)	640	1.3 (0.7-2.4)	736	1.8 (1.2-2.6)	581	1.1 (0.5-2.2)	796	1.5 (1.2-1.9)
0.6 -1	458	1.7 (1.1-2.7)	290	2.1 (1.1-4.0)	328	1.9 (1.2-2.9)	297	2.0 (1.0-4.1)	365	1.6 (1.3-2.1)
>1.0	243	2.5 (1.6-4.1)	157	2.2 (1.0-4.5)	179	2.4 (1.5-3.9)	159	4.9 (2.4-9.4)	208	2.3 (1.7-3.1)

n= number of users
Numbers restricted to those providing full information
All prevalence ratios adjusted for birth cohort, smoking, alcohol, anxiety and depression.
Prevalence ratios compare users with any symptoms to users with no symptoms

The association with tendency to somatise was more marked in those complaining of a higher number of symptoms. The prevalence ratios in those with four or more symptoms compared to none in users of any of the pesticide types were significantly higher in the second, third and highest levels of somatisation groups, compared to those with the lowest score. The association was weaker but statistically significant in those complaining of only one symptom (table 4.8).

Table 4.8 Association between symptoms to any pesticide type and somatising tendency

Somatising tendency score	No symptoms	One symptom		≥ 4 symptoms	
	n=2340	n =300	PR (95%CI)	n=225	PR (95%CI)
0 (lowest)	852	93	1.0	23	1.0
0.1 -0.5	916	116	1.1 (0.9-1.5)	73	2.9 (1.8-4.7)
0.6 -1	388	57	1.3 (0.9-1.9)	58	4.6 (2.8-7.6)
>1.0	184	34	1.7 (1.1-2.6)	71	8.8 (5.2-14.8)

Numbers restricted to those providing full information
All prevalence ratios adjusted for birth cohort, smoking, anxiety and depression.
All prevalence ratios compared to users with no symptoms

A higher somatising tendency score was also associated with a tendency to report symptoms in relation to more than one chemical (table 4.9).

Table 4.9 Symptoms in relation to one or more pesticide types and somatising tendency

Somatising tendency score	Symptoms in relation to one pesticide (n=384)		Symptoms in relation to two pesticides (n= 122)		Symptoms in relation to ≥ 3 pesticides (n=91)	
	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)
0 (lowest)	89	1.0	17	1.0	16	1.0
0.1 -0.5	177	1.6 (1.2-2.1)	41	1.8 (1.0-3.3)	29	1.5 (0.8-2.8)
0.6 -1	80	1.7 (1.2-2.3)	40	3.4 (1.9-6.2)	19	2.0 (1.0-4.0)
>1.0	38	1.7 (1.1-2.6)	24	3.4 (1.7-6.8)	27	4.2 (2.0-8.6)

Numbers restricted to those providing full information
n= number with symptom in relation to given number of pesticides
All prevalence ratios adjusted for birth cohort, smoking, anxiety, depression,
All compared to users with no symptoms. Analyses restricted to those subjects exposed to at least three chemicals through paid work.

The influence of other personality characteristics, (such as health anxiety and depression) on symptom reporting, was less, as shown in table 4.6. The data suggested trends of higher symptom reporting with increasing anxiety or depression but these findings were less consistent across pesticide types than those found for somatisation, and were not statistically significant.

There was no association between year of birth and reporting of at least one symptom after chemical use, except for lower reporting in the oldest five-year cohort. Ever smokers were significantly less likely to report symptoms and there appeared to be an inverse relationship between alcohol consumption and symptom reporting but the findings did not reach statistical significance.

In order to explore the possibility that the results might be influenced by symptom reporters being more likely respond to the questionnaire if they were high somatisers, we compared the association between somatising tendency score and reporting four or more symptoms to any pesticide type for early responders and for those who had been sent a reminder questionnaire (table 4.10). If anything, there was a stronger association in the late responders.

Table 4.10 Association between four or more symptoms to any pesticide type and somatising tendency in early and late responders

Somatising tendency Score	Responders before re-mailing Four or more symptoms n=1811		Responders after re-mailing Four or more symptoms n=754	
	n	PR (95%CI)	n	PR (95%CI)
0 (lowest)	616	1.0	258	1.0
0.1 -0.5	699	2.6 (1.5-4.5)	291	4.4 (1.5-13.0)
0.6 -1	314	4.0 (2.2-7.0)	132	6.9 (2.2-21.1)
>1.0	182	8.6 (4.7-15.5)	73	11.8 (3.7-37.7)

Numbers restricted to those providing full information
n=number with no symptoms + number with one symptom
All prevalence ratios adjusted for birth cohort, smoking, anxiety and depression.
All compared to users with no symptoms

4.7 Occupational characteristics

Using a modified Cox proportional hazards model,[310] prevalence ratios were derived for reporting any symptoms in relation to pesticides according to occupational characteristics.

4.7.1 Employment Status

Men who had ever been self employed in agricultural work were 1.6 times as likely to report symptoms following use of sheep dip as those who had always worked as an employee (table 4.11). For other pesticides there was no significant difference between employees and the self-employed in reporting any symptom. However, as with sheep dip, the reporting rate was lower among the employed.

4.7.2 Relation to extent of use and handling of concentrate

Table 4.11 also shows that handling concentrate and a higher number of days of chemical use were associated with a higher rate of symptom reporting following use of sheep dip and that a similar pattern of symptom reporting occurred following use of other pesticides.

The relation to somatising tendency score was present for each pesticide used even after adjustment for employment status, frequency of pesticide use and handling of concentrate.

Table 4.11 Relative risk of reporting any symptoms after pesticide use according to occupational characteristics and amount of use

	Herbicides n=2448 PR (95%CI)	Fungicides n=1481 PR (95%CI)	Insecticides n=1705 PR (95%CI)	Wood Pres. n=1399 PR (95%CI)	Sheep Dip n=1905 PR (95%CI)
Employment status					
Employee	1.0	1.0	1.0	1.0	1.0
Self employed	1.2 (0.8-1.6)	1.2 (0.7-1.9)	1.2 (0.9-1.6)	1.3 (0.8-2.1)	1.6 (1.3-1.9)
Both	1.4 (0.9-2.2)	1.5 (0.8-2.8)	1.5 (1.0-2.3)	1.5 (0.8-2.8)	1.5 (1.1-2.0)
Used Concentrate					
No	1.0	1.0	1.0	1.0	1.0
Yes	1.8 (1.0-3.4)	1.6 (0.8-3.2)	0.9 (0.6-1.3)	1.4 (0.8-2.3)	1.8 (0.7-2.3)
Total days of use					
<10	1.0	1.0	1.0	1.0	1.0
10-49	1.7 (0.9-3.2)	0.6 (0.2-1.4)	1.1 (0.6-1.9)	1.3 (0.7-2.5)	1.5 (1.1-2.0)
≥ 50	4.1 (0.1-0.4)	1.9 (0.9-3.7)	2.7 (1.7-4.5)	1.3 (0.7-2.5)	2.1 (1.6-2.7)
Somatising tendency score					
0 (lowest)	1.0	1.0	1.0	1.0	1.0
0.1-0.5	1.5 (1.0-2.3)	1.4 (0.8-2.6)	1.9 (1.3-2.8)	1.0 (0.5-2.1)	1.5 (1.2-1.9)
0.6-1.0	1.9 (1.2-3.0)	2.4 (1.3-4.6)	2.0 (1.3-3.2)	2.0 (1.0-4.0)	1.6 (1.2-2.1)
1.0-4.0	2.5 (1.5-4.1)	2.2 (1.0-4.6)	2.4 (1.5-4.0)	4.8 (2.3-9.8)	2.1 (1.6-2.9)

All analyses restricted to men who had ever worked in agriculture and used pesticides at work
Numbers restricted to those providing full information
All prevalence ratios were mutually adjusted and adjusted for birth cohort, smoking, alcohol consumption, anxiety and depression.

4.8 Risk of symptoms by age, calendar period and time since first use of any pesticide

The risk of first having symptoms, by time since first pesticide use, by age and by calendar period was estimated using a person-years approach and Poisson regression model. Users of any pesticide type (herbicides, fungicides, insecticides, sheep dip or wood preservatives) who provided adequate age information contributed to the denominator for the person-years analysis. The duration they had worked with pesticides was calculated from the first and last ages they reported using any pesticide type. Minimum ages were censored at 14 and maximum ages were censored at 64 (up until 65th birthday). If the age first worked with a particular pesticide was given, but not age last worked, the stop age was imputed as the age at mailing.

The calendar time period spent working with a pesticide was derived from the ages and month and year of birth. The year last worked with pesticides was censored at June 2003, if the age given suggested they were working with pesticides beyond that date.

Subjects who provided insufficient or inconsistent information could not be used in the person-years analysis. Of the 3275 men who reported ever working in agriculture and using pesticides at work, 41 were excluded because no first age was given and a further 146 gave no ages at all. Of the remaining subjects, 901 indicated a symptom within 48 hours of working with a chemical. However of these, 269 did not provide age information for first onset of symptoms, so could not be included in the analysis, and a further 18 were excluded because the reported symptoms occurred before stated occupational use of pesticides. This left a sample of 2800 users of pesticides at work of whom 614 had reported symptoms shortly after use.

In the person-years analysis observations were right censored according to the earliest event of first symptom, age last worked with pesticide or June 2003. One year was added to the person-year total for each subject to account for the seasonal nature of the agricultural work. So for example, a subject who stated age of first and last use of sheep dip as 20 would contribute one year to the person-years analysis.

The results suggested that the risk of symptoms following pesticide use at work was highest in younger workers and higher, after adjustment for age, during the first years of use. There also appeared to be an increased risk of reported symptoms during the 1980s and 1990s, peaking in the late 1980s (table 4.12).

It was not possible to repeat analyses for sheep dip alone because we only asked for the age at which symptoms first occurred in relation to pesticides overall. This could not necessarily be assumed to be the age at which first symptoms to sheep dip occurred if the particular symptom also occurred following use of other pesticide types. Therefore analyses were repeated on men who had ever worked in agriculture but who had never used sheep dip. In these subjects the risk of reporting symptoms appeared to increase in more recent time periods, particularly since 1985 but there was not a peak in symptoms during the 1980s, nor did the differences reach statistical significance. The risk of symptoms to other pesticides was highest during the first year of use and decreased with time since first use.

Table 4.12 **Risk of first symptom within 48 hours of occupational pesticide or sheep dip use among men who had ever worked in agriculture**

	Number with symptoms	Symptom rate per 1000 person years	IRR* (95%CI)
Time since first pesticide use			
Up to 1 year	92	32.9	5.4 (3.8-7.7)
>1 to 3 years	75	14.3	2.3 (1.6-3.2)
>3 to 5 years	68	14.0	2.0 (1.4-2.9)
>5 to 10 years	108	10.1	1.4 (1.0-1.9)
>10 to 15 years	84	9.2	1.3 (0.9-1.7)
Over 15 years	187	7.3	1.0 -
Age group			
14-19	123	17.4	1.0 -
20-24	126	13.6	1.1 (0.9-1.5)
25-29	83	9.2	0.8 (0.6-1.2)
30-34	93	11.4	1.1 (0.8-1.6)
35-39	41	5.7	0.6 (0.4-0.9)
40-44	65	11.0	1.0 (0.7-1.5)
45-49	36	7.6	0.7(0.4-1.1)
50-54	27	7.7	0.7(0.4-1.1)
55-64	20	5.7	0.6(0.3-1.0)
Calendar period			
1947-59	14	6.3	0.3 (0.2-0.7)
1960-64	23	7.5	0.5 (0.3-1.0)
1965-69	33	7.8	0.6 (0.4-1.1)
1970-74	33	6.0	0.5 (0.3-0.9)
1975-79	78	11.3	1.1 (0.7-1.7)
1980-84	96	12.0	1.2 (0.8-2.0)
1985-89	142	16.7	1.9 (1.2-3.1)
1990-94	99	12.0	1.6 (1.0-2.6)
1995-99	73	9.7	1.5 (1.0-2.5)
2000-03**	23	5.6	1.0 -

*Mutually adjusted incidence rate ratio, derived using person-years approach and Poisson regression model.

** censored June 2003

4.9 Regional differences in frequency of symptoms

The proportion of symptoms associated with types of pesticide was similar for herbicides, fungicides and wood preservatives in each of the three areas. However, in Lincolnshire the relative proportion of symptoms in relation to insecticides and sheep dip differed compared to the other two areas. Symptoms attributed to sheep dip were less common than in Devon or the Welsh Borders and symptoms attributed to insecticide use were more common (table 4.13). The slightly higher prevalence of any symptom after use of insecticide in Lincolnshire applied to most individual symptoms.

Table 4.13 Prevalence of any symptom in relation to sheep dip and insecticide by area*

	Devon	Welsh Borders	Lincolnshire
Sheep Dip	29.7%	32.4%	13.6%
Insecticide	11.5%	9.9%	16.1%

*Proportion of agricultural workers in each area who had used sheep dip or insecticide at work and reported at least one symptom which they attributed to that type of chemical

4.10 Leaving a job because of OP poisoning

Nine men reported leaving a job because of (OP) pesticide poisoning. One reported being poisoned by a farmer spraying crops on a windy day. The other eight were exposed while working in farming. Three of them were self-employed. In the eight exposed at work, all the chemicals implicated were used as veterinary medicines rather than crop spraying pesticides. Three had reported acute symptoms following use of insecticides on cattle and five implicated sheep dip as the cause of their acute symptoms. Each man only implicated one type of pesticide as the cause of his symptoms. In general there was a few years gap between age that first symptoms were reported and age left work. However some of the dates given may have been approximate (Table 4.14). All stopped using pesticides at the age they reported leaving a job because of ill health. When median scores for mental health and personality characteristics were compared to all responders, the results suggested that the prevalence of anxiety and depression and the tendency to worry about symptoms and report symptoms were greater in the eight subjects than in the population of responders (table 4.15).

Table 4.14 Farmers who left a job because of possible OP poisoning – Age and number of symptoms

Subject	Age at mailing	Age left job	Age first had symptoms	Number of symptoms	Chemical type
1	53	35	35	7	Insecticide
2	34	32	23	3	Insecticide
3	56	51		3	Insecticide
4	52	48	40	6	Sheep dip
5	67	59	50	12	Sheep dip
6	66	53	50ish	9	Sheep dip
7	53	36	Early 30s	4	Sheep dip
8	67	55	40	5	Sheep dip

Table 4.15 Mental Health traits in eight subjects who left a job and in all responders

Mental Health Trait (range of scores possible)	Health Anxiety (0-14)	Anxiety (0-21)	Depression (0-21)	Somatisation (0-4)
Median score 8 men* (IQR)**	2.5 (2.0-4.0)	4.8 (3.0-8.5)	4.0 (2.0-9.5)	0.3 (0.1-1.1)
Median score total sample (IQR)	1.0 (1.0-3.0)	4.0 (2.0-7.0)	3.0 (1.0-5.0)	0.1 (0.0-0.6)

*8 farmers who stopped work because of OP poisoning
** interquartile range

Table 4.16 shows the acute symptoms reported by each subject who later left work because of problems related to OPs. Each subject reported multiple symptoms. Each subject who implicated sheep dip reported at least three of the four symptoms associated with flu like illness, but there was no clear pattern in the symptoms reported.

Table 4.16 Acute symptoms reported to insecticide or sheep dip in farmers who later left work because of OP related symptoms.

Symptom	Subject 1	2	3	4	5	6	7	8
Runny nose					■	■	■	■
Headache		■	■	■	■	■	■	■
Aching limbs	■		■	■	■	■		■
Fever or chills				■	■		■	
Giddiness		■	■	■	■		■	
Restlessness or anxiety	■				■	■		■
Inability to concentrate	■				■	■		■
Difficulty breathing	■				■			
Diarrhoea					■	■		
Blurred vision	■				■	■		
Muscle weakness	■	■		■	■	■		
Numbness or tingling *	■			■	■	■		

*in your hands or feet that lasted longer than 3 minutes

Insecticide
Sheep dip

4.11 Summary of main findings

Reporting symptoms shortly after pesticide use was common; 27% of users reported at least one symptoms following use of a pesticide. The frequency of at least one symptom varied by type of pesticide and by area. Symptoms were most frequent following use of sheep dip in Devon and the Welsh Borders, but in Lincolnshire a higher proportion of subjects reported symptoms following insecticide use. The pattern of symptoms reported for each pesticide type was similar, with headache being the most frequent symptom reported. A large proportion of symptom reporters had multiple symptoms. Symptoms in relation to individual pesticide types did tend to cluster, but the pattern was similar for different pesticide classes. There was no evidence of a specific syndrome. In particular there was no evidence of 'dippers flu' among users of sheep dip. In individuals, symptoms in relation to more than one type of pesticide were more frequent than expected assuming that reported symptoms after use of each pesticide type were independent of each other.

Possible risk factors for symptom reporting were identified. These were short time since first using a pesticide and calendar period, with peak reporting rates occurring in the late 1980s. There was also an association with tendency to somatise, particularly among multiple symptom reporters. We found a positive association between symptom reporting and increasing frequency of use or use of concentrate. Only eight men (out of 3275 agricultural workers exposed) reported leaving a job because of symptoms relating to pesticide exposure at work.

4.12 Strengths and limitations of the study

A strength of the study design was that by being population based, there was the potential to collect information from men who had worked in agriculture at any time during their lives. This was valuable because some men may have left agricultural work because of health problems we were interested in, and others may have experienced health problems but left for other reasons. There were a large number of respondents who had worked in agriculture and used pesticides, enabling us to analyse the data in some detail with reasonable power.

However a potential limitation in interpreting study results was the low response rate which could lead to bias if responders differed from non-responders in relation to symptom prevalence following pesticide use. In order to assess the possible magnitude of response bias we looked at the frequency of symptoms reported by first time and late responders. The results suggested that the impact of response bias was probably small. It is less likely that response bias had much impact on the association between symptoms and possible risk factors, because this would imply selective non-response of pesticide users without symptoms but with risk factors.

Another consideration in interpreting results was recall bias. This may have been in the form of differential recall bias i.e. symptoms prompting recall of pesticide exposure, or non-differential error of recall influenced by how long ago symptoms occurred. The first would have the effect of increasing the association between exposure and symptoms if it occurred to any extent. However the questions about pesticide exposure and symptoms were not linked in the questionnaire. The first came early in the questionnaire, while that about symptoms following use was at the end, so it is unlikely that one prompted answers to the other. However, they could be linked in the responder's mind, irrespective of study design. Failure to recall symptoms would cause us to underestimate the effect of exposure.

4.13 Discussion of results

4.13.1 Frequency and nature of symptoms

Reporting of symptoms was common especially following use of sheep dip. The relative frequency of individual symptoms reported showed a similar pattern for all pesticide types, with headache being the most common symptom.

It is possible that those with symptoms preferentially responded and given the low response rate this could be important. The study was designed to try and minimise this type of response bias in that the questionnaire was quite general and pesticides were only one of number of health problems that we asked about. In sub analyses, the prevalence of any symptoms in first time responders was slightly higher than in late responders and marginally higher for most individual pesticide types. Also in responders to the smaller GP study, which had a better response rate to the first mailing than the main study, there was a slightly lower frequency of any symptoms, 24% compared to 28% in the main study. So there may have been some response bias but the magnitude was probably small. If we assume that all the non-responders had no symptoms following pesticide use (and that the proportion of ever farmers and pesticide users was similar in the non responders and responders) then the frequency of symptoms would have been around 10% instead of around 30%, which is still not uncommon.

If some pesticide users did not recall symptoms in relation to pesticide use, this would lead to an underestimate of symptom frequency. While it is possible that occasional symptoms in regular users may have been overlooked, it seems unlikely that there was major underreporting. In fact 143 subjects reported symptoms after pesticide use, but did not report pesticide exposure in a paid job. Most of them had jobs that were consistent with pesticide use at work, but we could not assume this, so these subjects were not included as pesticide users. If they had been included this would have increased the frequency of any symptom to any pesticide from 26.8% to 29.9%.

The number of ever users of pesticide types was used as a denominator to calculate the proportion of symptom reporters. There may have been under- reporting of use at work, either because it was forgotten or the question was misunderstood. It became apparent after mailing the first questionnaire that a few self-employed farmers did not consider themselves to be in a paid job. The effect of inaccurate reporting of use was probably small because of the large number of users in our sample.

There have been few other studies assessing the frequency of symptoms in the same way that we have. Most data on acute symptoms has been collated from patients seeking medical attention or registering complaints and the frequency of symptoms detected through these routes is rare. A study conducted by HSE, of self-reported symptoms in licensed pesticide users found that 5% of current users reported at least one acute symptoms, in the previous 12 months that they thought was caused by a pesticide and about which they had consulted a doctor. The proportion rose to 15% if symptoms thought to be made worse by pesticides or about which a doctor had not been consulted were included.[316] Headache was by far the most common pesticide related symptom reported.

In this study, not all symptoms recorded in relation to pesticide use were necessarily caused by the pesticide. We asked subjects if they had suffered symptoms following pesticide use. Some commented that they did not think the symptoms were caused by a pesticide. We did not seek to identify perceived cause of symptoms in this study, but factors such as intensity of work at the time pesticides were being used, or hot weather, may have contributed to some symptoms. Therefore some symptoms may be associated with the package of work and environment rather than just pesticide use.

Severity of symptoms was not formally assessed nor whether men carried on using pesticides after experiencing symptoms. Therefore it is unclear how incapacitating reported symptoms were.

4.13.2 Multiple symptoms, multiple pesticides

Multiple symptom reporting in individuals was more frequent than expected if reporting of symptoms were statistically independent. Certain symptoms did cluster but the pattern was similar for all pesticide types, so there was no evidence of a unique syndrome. Furthermore flu-like symptoms following use of sheep dip were only weakly associated with each other in our study.

It is possible that those with multiple symptoms preferentially responded to the questionnaire, especially if they blamed pesticide exposure. However, it is unlikely that this would have affected the patterns of clustering that we detected.

No other studies have been identified that considered clustering of symptoms in the way that we have. While dippers flu is recognised in the farming community and accepted by some researchers, its existence as a syndrome is based mainly on anecdotal evidence. Severe and incapacitating episodes of dippers flu have been included as part of a proposed syndrome of chronic toxicity.[32] However questions used in studies assessing the prevalence of the proposed syndrome merely asked if subjects had experienced flu-like symptoms.[33] In our study, while headache and aching limbs were particularly common symptoms and runny nose and fever were not uncommon, these symptoms rarely occurred together as a syndrome and clustering that did occur was not specific to sheep dip, so not compatible with specific poisoning. Thus our evidence does not support the existence of a syndrome consisting of these symptoms that is specifically associated with sheep dip.

The frequent occurrence of symptoms in relation to several types of pesticides that were toxicologically distinct suggested that factors besides toxicity might have influenced symptom reporting. Some association between symptoms in users of sheep dip and other insecticides might be expected because there is overlap in the two groups in active substances they contain. In those who complained of symptoms with insecticides, sheep dip and wood preservatives, we did look at names of chemicals where given, but the data were not specific or complete enough for us to define whether symptom reporting to multiple pesticide types was associated with pesticides of similar chemical content. Even if overlap in chemical content was a reason for some of the symptom reporting in relation to several classes of pesticides the fact that pair-wise associations between reporting symptoms to sheep dip and other individual pesticide types were no stronger for insecticides (most likely to contain similar chemicals) than for other pesticide types suggests that the associations cannot be accounted for wholly by toxicological mechanisms.

4.13.3 Amount of use.

In sheep dip users, the risk of symptoms in those who had ever handled concentrate was higher than in those who had not. The same was true for other pesticide types except for insecticide users in whom there was no association between use of concentrate and any acute symptoms. The number of days of use was also a risk factor for symptom reporting.

It is unlikely that response bias influenced these results unless intensive pesticide users preferentially responded. There was some missing data, but probably insufficient to influence the pattern of results. For example 91% of users of sheep provided sufficient information to be included in the analysis. It is possible that more frequent users of pesticides were most likely to recall symptoms because of safety awareness and concerns, or there was a higher probability of coincidental symptoms related to higher number of days of use. However, it is unlikely that this effect was large enough to account for the results. There was a positive association between ever having used concentrate and reporting any symptoms after use, although it was not specific to sheep dip. Previous work, based on excretion of urinary metabolites, has suggested that the majority of uptake of OP sheep dip followed use of concentrate[21]. The number of dipping days has been shown to be associated with self-reported ill-health in relation to any pesticide, in a survey of licensed agricultural pesticide users in Great Britain.[316] It is not clear whether this was due to a short term cumulative effect, or whether use of pesticides just happened to coincide with symptoms. The use of personal protective equipment has been reported to be quite poor in regular sheep dip users,[21] and in many other pesticide users.[316] In the survey of British licensed pesticide users, those who wore a basic level of PPE were around one third less likely to report symptoms related to pesticide use than those who did not. The difference was greater for high users (40 days or more in the past year).[316]

This apparent dose response effect is consistent with our findings and supports a toxic mechanism for symptoms to any pesticide type including sheep dip, but could be a chance association given that the most frequent symptoms occur commonly anyway.

4.13.4 Time associated risk factors

Three risk factors for first occurrence of symptoms after use of any pesticide were considered. These were time since first used, age and calendar period. The risk of any symptom decreased with duration of use, with the highest risk being in the first year of use and decreased with increasing age. The peak rate of symptom reporting, particularly among users of sheep dip coincided with compulsory dipping.

It is unlikely that long-term users who had symptoms in relation to pesticide use were over-represented among non-responders to the questionnaire, so response bias probably did not influence results. However recall bias was an issue. Because of missing information we could not include all symptom sufferers in the temporal analysis. Only two thirds of symptom reporters could be included in the analysis because others did not give age of first symptoms.

It is possible that subjects were more likely to recall age of first symptoms if they related it to something specific such as enforced use, or soon after starting a job. The peak risk in the 1980s was probably not just due to failure of recall because since that time there has been a decreasing trend in risk and one would expect recall for more recent symptoms to be better than in the 1980s.

There were other factors, particularly in relation to sheep dip, that could account for the patterns we observed if it was not just recall bias. These were frequency and amount of use, type of pesticides used and enforced use together with increased publicity about possible adverse effects.

Increased exposure to sheep dip during the time of compulsory dipping may have been a factor. Sales of OP sheep dips peaked in 1986 which was around the time sheep dipping, twice per year, became compulsory (1984-1988).[18] Subsequently sales gradually declined until 1992, and they have declined more rapidly since compulsory annual sheep dipping was discontinued in July 1991. Based on data supplied by the Veterinary Medicines Directorate (VMD) the number of acute and chronic suspected adverse reaction reports peaked in 1991,[18] coinciding with publicity about discontinuing compulsory sheep dip use. The data in our study suggests the peak incidence rate of new symptoms actually began earlier than 1991, coinciding with the period when compulsory dipping was initiated. The differences may be partly accounted for by the mode of collection of data. Our data relied on recall and the VMD data relied on a prompt to report symptoms. Also our data only included first symptoms. The number of users may have changed over the period, so trends in numbers (VMD data) and our rates are not directly comparable, but use was probably falling when the VMD numbers peaked.

The number and variety of sheep dip products registered has been decreasing since the 1980s. Between 1988 and 1994 licenses expired for several active OP ingredients including carbophenothion, chlorfenvinphos,chlorpyrifos, coumaphos and crotoxyphos. By 1998 only two OP compounds were licensed in the UK for use in sheep dips. These were diazinon and propetamphos.[18] More OP ingredients were licensed for use as insecticides.[18, 317]. The peak incidence of first symptoms did occur during a period of increased regulation and some of the compounds no longer available were still in use. However, these compounds (and more toxic ones) were in use during earlier years before the peak in reporting occurred. Therefore the nature of the compounds used cannot be a sole factor.

Another possibility is that increased susceptibility of users was influenced by adverse publicity about OP sheep dips and compulsory use, or that these factors made subjects more likely to recall symptoms, because they were aware of concerns. Previous work has shown that perceived risks are increased if exposure is involuntary, including work-associated exposure, and that risk perception is influenced by beliefs and the media. [318, 319]

The finding that younger users and new users of pesticides were at the highest risk of new symptoms suggests that behavioural factors such as careless handling of concentrate because of inexperience, rather than changes in types of pesticide used over the years may be of more importance. Other work suggests that newly hired workers tend to have higher accident rates.[320]

4.13.5 Personal characteristics

Of the personal and mental health characteristics we considered, somatisation was the most strongly associated with symptom reporting, particularly in subjects reporting four or more symptoms. There was no clear association with depression, anxiety or health anxiety (hypochondriasis).

It is unlikely that the associations found between symptom reporting and somatising tendency were influenced by the low response. There was a clear dose-response gradient. Non-responders would have to include a high proportion of multiple symptom reporters who were non-somatisers to negate the strong positive association between multiple symptom reporters and tendency to somatise. It seems very unlikely this group would have selectively non-responded especially in large numbers. Also, when we compared early and later responders, if anything, the association between somatising tendency and high symptom reporting was even stronger in the late responders.

The instrument used to measure somatising tendency was a validated measure that has been used in many other studies. However, some of our outcome measures were not dissimilar to symptoms used to identify somatising tendency. It is possible that this overlap could account for the association with high symptom reporting we observed. Only six of the twelve symptoms we asked about following pesticide use were similar to symptoms used to assess somatisation. While this accounted for most of the symptoms contributing to a somatising tendency score the time period in which symptoms occurred may have been different (symptoms in the past 7 days to assess somatising tendency vs ever had symptoms following pesticide use) so it does not follow that the questions were assessing the same thing. The symptoms most similar to somatising indicators were not the most frequent symptoms (3 to 6% for individual symptoms), nor were they the symptoms that clustered most, so multiple symptom reporters may not have had any of the symptoms in question. We did not compare symptoms reported by individuals with those contributing to their somatisation score to see if there was a correlation.

Assuming that the association between somatising tendency and symptoms was real, because of the nature of the study design, we could not determine whether the tendency to somatise came before or after symptoms. It is possible that because somatisers tend to experience symptoms more often they were more likely to coincidentally have symptoms after pesticide use.

Studies being carried out in Bristol have looked in more detail at the association between somatisation and arm pain. The results of a longitudinal study showed that somatising level was both a precursor and a predictor of new onset pain. Other mental health measures used were much weaker predictors of pain.[319] At the time of writing it was not clear whether the presence of pain affected later levels of somatising tendency in this study.

4.13.6 Differences by area

The differences by area, (i.e. symptoms following sheep dip use were less common in Lincolnshire), were unlikely to be accounted for by differences in total days of use or use of concentrate because the amount of use of sheep dip was similar in users from each area. Response rate by area was almost the same, so response bias probably did not account for the differences. It remains possible that there were differences in use by time period, or that our assessment of amount of use was not sensitive enough to pick up significant differences, but this is not very likely. Another factor could be the specific pesticides used, but given the general availability and choice of sheep dip products and lack of specificity of symptoms it seem unlikely that this was an important determinant of frequency of symptoms.

The observed regional differences could be accounted for by psychological mechanisms, prompted by publicity about possible adverse effects. In the areas where sheep farming is most common, particularly Devon, there has been considerable publicity about OP pesticides prompted by local pressure groups. It is recognized that at a population level, when there is adverse public and media opinion about a chemical, perceived risks of low level exposure become magnified.[354] It is conceivable that similar factors operate among users of OP products.

4.13.7 Long term effects on work capacity

We did not ask about severity and consequence of symptoms though there was probably a spectrum. A minority of subjects did not attribute their symptoms to pesticide use while others most certainly did. However this was not something we formally recorded. Nor could we assess if age of first symptoms to specific pesticides coincided with stopping use of those pesticides.

Although there were only eight subjects who left a farm job because of alleged OP pesticide poisoning, and the differences could be attributed to chance, there was a suggestion that severe depression and anxiety and the tendency to somatise were greater in the eight subjects. It cannot be said, from the data, whether the possible associations were cause or effect.

4.14 Conclusions

Experience of symptoms following pesticide use was common. The symptoms we asked about were those recognised to be associated with acute and sub-acute poisoning. While symptoms may have been severe and possibly a result of direct toxicity, our data suggests that many of the symptoms reported may not have been. The lack of specificity of symptoms in relation to pesticide types and reports of symptoms to multiple pesticide types in individuals do not support a toxicological mechanism. Also differences in relative symptom prevalence by area following sheep dip and insecticide use, and the association between multiple symptom reporting and somatisation suggest that in many subjects psychosomatic and social or environmental factors may have a role. The dose response would be consistent with direct toxicity, but might also reflect reporting bias. The findings do not indicate a need for further regulatory action on existing pesticides at this stage, though the apparent increased risk in new users suggests that supervision and training may be inadequate.

Another issue is whether the symptoms we have identified matter. This must depend on the severity and consequence of acute symptoms, whether short-term effects are a precursor of longer-term symptoms and the reason why people have symptoms. A further question is whether there is something about multiple symptom reporters that makes them more susceptible to longer-term or more severe short- term acute symptoms. The findings and discussion concerning risk factors for longer-term symptoms are presented in the next chapter. Specific questions that could be addressed to determine the importance of symptoms following pesticide use include

- What proportion of symptoms are long lasting or recurrent and compromise work?

- In those who continue to use specific pesticides after experiencing symptoms, do symptoms recur? Which symptoms, how often and how seriously?

- Are men who take action e.g. stop using pesticides because of symptoms, different from those who do not (for example personal and mental health factors).

- Is prior somatising tendency a useful predictor of reporting symptoms following pesticide use?

- Also further investigation of men with repeated consistent symptoms or severe symptoms following use, including more objective measures of exposure and absorption may be helpful. (These correlate poorly with symptoms in other studies).

Answers to these questions would inform how and when prevention of adverse consequences might be possible, and give further insight into how to manage and counsel people who complain of symptoms that they attribute to OP sheep dip use. The first three bullet points could be addressed by questionnaire to the symptom reporters in this study who have agreed to be contacted again.

CHAPTER 5: CURRENT HEALTH IN RELATION TO PESTICIDE USE IN AGRICULTURAL WORKERS

5.1 Introduction

This chapter reports on symptoms that have commonly been attributed to chronic OP poisoning. While many symptoms have been attributed to OP exposure, by individuals,[18] most evidence relates to neuropsychiatric effects. In order to investigate whether certain neuropsychiatric symptoms or illnesses are associated with exposure to pesticides, and particularly sheep dip, information was collected on a range of neuropsychiatric symptoms including anxiety and depression. The frequency of symptoms, and whether there was an excess of current neuropsychiatric symptoms in agricultural workers who had used sheep dip was assessed. In those who had used sheep dip, whether current symptoms were more common in those who had previously expressed acute symptoms after dipping sheep and the association between somatising tendency and symptom reporting were also explored.

A syndrome has been postulated, comprising at least seven out of the ten problems listed in table 5.1, called Chronic Organophosphate Induced Neuropsychiatric Disorder, (COPIND).[32] We did not ask about COPIND symptoms directly but indicators of the proposed symptoms were distributed among other questions in the questionnaire. Seven items in question 32 that asked about neuropsychiatric symptoms were selected. These reflected six of the proposed symptoms. Other items from question 37 and question 40 were used as indicators of other proposed symptoms (see table 5.1).

Table 5.1 ***Symptoms we asked about compared to items used in proposed COPIND.***

	Proposed symptoms*	Items in questionnaire used to assess neuropsychiartic symptoms
I	severe incapacitating episodes of dippers flu	Qu 40[1] fever or chills – (following sheep dip/pesticide use)
ii	personality change with mood destabilisation	Qu 37[2] – change in personality e.g. a tendency to depression or irritability– (after started sheep dip or insecticide use)
iii	impulsive suicidal thinking	Qu 37[2] –thoughts about harming yourself or committing suicide (after started sheep dip or insecticide use)
iv	memory and attention impairment	Qu 32[3] – difficulty concentrating, difficulty remembering things
v	language disorder	Qu 32[3] – difficulty speaking (e.g. in finding the right words or getting words out)
Vi	alcohol intolerance	Qu 32[3] – increases sensitivity to the effects of alcohol
vii	heightened olfactory acuity	Qu 32[3] – sensitivity to certain smells (e.g. perfume)
viii	extreme sensitivity to organophosphates	Qu 40[1] – at least 4 of listed symptoms (after sheep dip/pesticide use)
ix	handwriting deterioration	Qu 32[3] – difficulty with your handwriting
x	inability to sustain muscular activity	Qu 32[3] - tiredness and lack of energy
		Qu 34 – hospital anxiety and depression scores

*It has been proposed that at least 7 out of the 10 suggests a syndrome[32, 33]
1. Stem to qu 40 = "Have you ever suffered from any of the following within 48 hour of working with a pesticide or sheep dip?" (choice of 12 symptoms listed and asked to specify type of chemical). Used as potential risk factors in our analyses, because not applicable to men who were not exposed to pesticides.
2. Stem to qu 37 = "Have you ever suffered from any of the following badly enough to see, attend hospital or take time off work?" Responses to 'saw GP' used in analysis. (18 items listed, age first saw GP was asked for).
3.Stem to qu 32 = "During the past month have you had any of the following? For each question please give one answer that comes closest to how much you have suffered in the past month." (12 questions, frequency from none to all of the time, positive taken as 'a good bit of the time' or more frequently)

From information collected about ever seeing a GP for a range of specific symptoms, (question 37) associations between each of four symptoms and pesticide exposure were explored. Using the ages given for first seeking medical attention it was possible to ascertain whether the problem first occurred before or after the age chemicals were first used at work.

Two of the proposed COPIND symptoms (i and viii in table 5.1) should, by definition, only have occurred in sheep dip or organophosphate users, so it was not feasible to include these in comparisons of symptom frequency with non-users. In our analysis we considered these presentations as potential risk factors for long-term symptoms in sheep dip users.

The analyses presented in this chapter were confined to 4339 men who had ever worked in agriculture. They included 1361 who had never used pesticides at work, and 1879 who had used sheep dip. Prevalence ratios in different groups of agricultural workers were estimated using a modified Cox's proportional hazards model.

5.2 Frequency of neuropsychiatric symptoms in relation to pesticide use

The frequency of neuropsychiatric symptoms for categories of pesticide exposure is shown in tables 5.2 and 5.3. The frequency of reported neurological and psychiatric symptoms was marginally lower in men who had never worked in agriculture compared to those who had (table 5.2). Within agricultural workers the frequency of most symptoms was higher in pesticide users than non users, but frequencies were similar in those who had used sheep dip and pesticide users who had not used insecticides or sheep dip (table 5.3).

Table 5.2 Frequency of neurological and psychiatric symptoms in men, in relation to work in agriculture

	Ever agricultural workers n=4339		**Never agricultural workers n=5505**	
	n	(%)	n	(%)
Tiredness and lack of energy[1]	774	(17.8)	886	(16.1)
Difficulty remembering[1]	398	(9.2)	440	(8.0)
Sensitivity to smells[1]	268	(6.2)	264	(4.8)
Difficulty concentrating[1]	220	(5.1)	225	(4.7)
Difficulty with handwriting[1]	141	(3.2)	157	(2.9)
Sensitivity to alcohol[1]	137	(3.2)	128	(2.3)
Difficulty speaking[1]	133	(3.1)	137	(2.5)
Anxiety[2]	922	(21.2)	1062	(19.4)
Depression[2]	544	(12.5)	617	(11.2)

1 - symptoms in the past month at least a good bit of the time
2- HAD score of 8 or more

Table 5.3 Frequency of neurological and psychiatric symptoms in relation to pesticide use in men who had ever worked in agriculture

	Never worked with pesticides n=1361		Ever worked with sheep dip n=1879		Ever worked with insecticides but not SD* n=664		Ever worked with other pesticides not I or SD* n=435	
	n	(%)	n	(%)	n	(%)	n	(%)
Tiredness and lack of energy[1]	199	(14.6)	394	(21.0)	101	(15.2)	80	(18.4)
Difficulty remembering[1]	102	(7.5)	194	(10.3)	64	(9.6)	38	(8.7)
Sensitivity to smells[1]	61	(4.5)	132	(7.0)	43	(6.5)	32	(7.4)
Difficulty concentrating[1]	61	(4.5)	104	(5.5)	32	(4.8)	23	(5.3)
Difficulty with handwriting[1]	43	(3.2)	70	(3.7)	11	(1.7)	17	(3.9)
Sensitivity to alcohol[1]	37	(2.7)	62	(3.3)	19	(2.9)	19	(4.4)
Difficulty speaking[1]	44	(3.2)	55	(2.9)	20	(3.0)	14	(3.2)
Anxiety[2]	268	(19.7)	415	(22.1)	130	(19.6)	109	(25.1)
Depression[2]	165	(12.1)	254	(13.5)	76	(11.4)	49	(11.3)

*SD = sheep dip, I= insecticides
1 - symptoms in the past month at least a good bit of the time
2- HAD score of 8 or more

Tables 5.4 and 5.5 show the frequency and rate of ever consulting a GP for "change in personality (e.g. a tendency to depression or irritability)", for "thoughts about self-harm" and difficulty speaking or with handwriting. The difference in frequency of symptoms reported to a GP between ever and never agricultural workers did not show a consistent pattern (table 5.4).

Within agricultural workers the rates per 1000 sheep dip users, insecticide users, users of pesticides other than sheep dip or insecticides and never users are shown in table 5.5. For the psychiatric symptoms, change in personality and thoughts about self-harm, rates were highest in users of sheep dip although consultation rates were also elevated in men who had worked with pesticides other than insecticides or sheep dip. These excesses persisted even when consultations before first working with the relevant pesticide were excluded. However, the differences observed may have been due to chance (p values for differences in rates of consultation in sheep dip users compared to those who had never worked with pesticides were 0.06 and 0.07 respectively). No increased prevalence of consultation was found for difficulty with speaking or handwriting, and work with insecticides other than sheep dip was not associated with consultation for any of the four indications.

Table 5.4 Lifetime prevalence of consultation with GP because of neurological and psychiatric symptoms according to work in agriculture

	Ever worked in agriculture n= 4439		Never worked in agriculture n= 5505	
	n	*Rate per 1000*[1]	n	*Rate per 1000*[1]
Change in personality	338	*78*	475	86
Difficulty speaking	97	*23*	107	19
Difficulty with handwriting	70	*16*	84	15
Thoughts about self harm	104	*24*	165	30

[1]Age standardised rate per 1000

Table 5.5 Lifetime prevalence of consultation with GP because of neurological and psychiatric symptoms according to earlier work with pesticides

	Never worked with pesticides		Ever worked with sheep dip		Ever worked with insecticides but not SD[1]		Ever worked with other pesticides not I or SD[1]	
	n	*Rate per 1000*[2]	n	*Rate per 1000*[2]	n	*Rate per 1000*[2]	n	*Rate per 1000*[2]
Change in personality	96	*69*	162	*88*[a]	43	*64*	37	*80*
Difficulty speaking	35	*23*	37	*21*	15	*23*	10	*21*
Difficulty with handwriting	23	*16*	30	*17*	9	*15*	8	*18*
Thoughts about self harm	25	*18*	53	*28*[b]	13	*19*	13	*32*[c]

[1]SD = sheep dip, I= insecticides
[2]prevalence rate per 1000 subjects directly standardised to age distribution of all 'ever farmers' sampled, [a-c]p values for difference in rate compared to never worked with pesticides: a= 0.06, b=0.07, c=0.07. For other rate differences in pesticide users p>0.40.

Some subjects reported that, in the past month, they had had several of the seven symptoms listed in upper part of table 5.3, at least a good bit of the time. The number of men who reported zero to seven symptoms in the past month is shown in table 5.6. In order to calculate expected numbers, the probability of symptoms in relation to exposure for each symptom was estimated from the proportion of workers in each exposure category with that symptom. With the assumption that the probabilities were independent (i.e. reporting one symptom did not affect the probability of reporting other symptoms), we then calculated the probability of reporting possible combinations of 0,1,2,3,4,5,6 and 7 symptoms in relation to category of exposure. These probabilities were applied to the number of subjects in each category to derive the total expected number of men in the sample with symptoms relating to each number of pesticide types.

In men who had worked with sheep dip the number who reported three or more symptoms was much higher than expected, but the same was true for those who had worked with other types of pesticides and those who had not used pesticides at work. A small proportion of men who had used sheep dip at work reported six or seven symptoms (at least some of the time) but the proportion was similar in men who had never worked with pesticides.

Table 5.6 Observed and expected numbers of neuropsychiatric symptoms in relation to pesticide use in ever agricultural workers

Number of symptoms°	All subjects n=4339		Never worked with pesticides n=1361		Ever worked with sheep dip n=1879		Ever worked with insecticides but not SD* n=664		Ever worked with other pesticides not I or SD* n=435	
	Observed n (%)	Expected n	Observed n (%)	Expected n	Observed n (%)	Expected n	Observed n (%)	Expected n	Observed n (%)	Expected n
0	3144 (72.5)	2619	1041 (76.5)	894	1301 (69.2)	1057	496 (74.7)	420	306 (70.3)	253
1	721 (16.6)	1402	200 (14.7)	394	346 (18.4)	653	96 (14.5)	203	79 (18.2)	146
2	257 (5.9)	286	66 (4.8)	67	126 (6.7)	151	38 (5.7)	38	27 (6.2)	33
3	111 (2.6)	30	24 (1.8)	6	51 (2.7)	17	25 (3.8)	4	11 (2.5)	4
4	51 (1.2)	1.7	16 (1.2)	0.3	27 (1.4)	1.1	3 (0.2)	0.2	5 (1.1)	0.3
5	37 (0.9)	0.1	8 (0.6)	0.0	18 (1.0)	0.0	5 (0.8)	0.0	6 (1.4)	0.0
6	12 (0.3)	0.0	3 (0.2)	0.0	8 (0.4)	0.0	1 (0.2)	0.0	0 (0.0)	0.0
7	6 (0.1)	0.0	3 (0.2)	0.0	2 (0.1)	0.0	0 (0.0)	0.0	1 (0.2)	0.0
≥ 3	217 (5.0)		54 (4.0)		106 (5.6)		34 (5.1)		23 (5.3)	
≥ 4	106 (2.4)		30 (2.2)		55 (2.9)		9 (1.4)		12 (2.8)	

*SD = sheep dip, I= insecticides

°symptoms = difficulty concentrating, difficulty remembering things, difficulty with handwriting, difficulty speaking, sensitivity to smells, sensitivity to alcohol and tiredness and lack of energy

5.3 Association between neuropsychiatic symptoms and pesticide use

Using a modified Cox's proportional hazards model, prevalence ratios were calculated for men exposed to pesticides compared to men who had not worked with pesticides, for at least three or four neuropsychiatric symptoms, each for at least a good bit of the time in the past month, and for at least moderate anxiety and depression. The results are shown in table 5.7.

The risk of three or four or more symptoms tended to be higher in pesticide users, though this was not specific to sheep dip users. Risks were highest in users of sheep dip, though only marginally higher than in men who had not used sheep dip or insecticides. The risk of anxiety or depression was quite similar between groups.

Table 5.7 Prevalence ratios for neuropsychiatric symptoms in relation to pesticide use

Occupational exposure to pesticides	≥ 3 symptoms°		≥ 4 symptoms°		Anxiety		Depression	
	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)
Never worked with pesticides	54	1.0	30	1.0	268	1.0	165	1.0
Ever worked with sheep dip	106	1.5 (1.1-2.0)	55	1.4 (0.9-2.3)	415	1.1 (0.9-1.3)	254	1.2 (0.9-1.4)
Ever worked with insecticides –but never SD*	34	1.2 (0.7-1.8)	9	0.5 (0.2-1.1)	130	0.9 (0.7-1.1)	76	0.8 (0.6-1.1)
Ever worked with pesticides –never SD or I*	23	1.4 (0.8-2.2)	12	1.3 (0.7-2.5)	109	1.2 (1.0-1.5)	49	0.9 (0.7-1.3)

°3 or more/4 or more symptoms at least a good bit of the time in the past month out of seven symptoms (difficulty concentrating, difficulty remembering things, difficulty with handwriting, difficulty speaking, sensitivity to smells, sensitivity to alcohol and tiredness and lack of energy)
Anxiety - HAD score 8 -21
Depression - HAD score 8 -21
PR – prevalence ratio adjusted for age group and area
*SD = sheep dip, I= insecticides

We explored the impact of somatising tendency on risk of symptom reporting. The tendency to somatise was scored using a severity index i.e. sum of severity scores divided by number of items scored (as described in chapter 3, section 3.5.2), but instead of including all seven items, only five were used. The neuropsychiatric symptoms, 'feeling weak in parts of the body' and 'numbness and tingling' that are used as indicators of somatisation were not included because these symptoms have also been associated with sub-acute or chronic OP toxicity.

Table 5.8 shows that the tendency to somatise was strongly associated with three or more and four or more symptoms for at least a good bit of the time in the past month. There was also a clear association with anxiety and depression.

Adjusting for somatisation accounted for much of the difference in risk of symptoms in pesticide users compared to non-users (lower part of table 5.8 compared to table 5.7).

Table 5.8 Neuropsychiatric symptoms and somatising tendency in agricultural workers

	≥ 3 symptoms		≥ 4 symptoms		Anxiety		Depression	
	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)
Somatising tendency score								
0	40	1.0	18	1.0	265	1.0	140	1.0
0.1-0.5	34	1.6 (1.0-2.6)	10	1.1 (0.5-2.3)	262	1.9 (1.6-2.3)	143	2.0 (1.6-2.5)
0.6-1.0	66	6.6 (4.4-9.7)	28	6.2 (3.4-11.2)	236	3.6 (3.0-4.3)	143	4.1 (3.2-5.2)
>1.0	75	16.7(11.3-24.6)	48	24.0 (13.9-40.4)	153	5.4 (4.4-6.6)	116	7.4 (5.8-9.5)
Occupational exposure to pesticides								
Never worked with pesticides	54	1.0	30	1.0	268	1.0	165	1.0
Ever worked with sheep dip	106	1.2 (0.9-1.7)	55	1.1 (0.7-1.8)	415	1.0 (0.8-1.2)	254	1.0 (0.8-1.3)
Ever worked with insecticides –but never SD*	34	1.1 (0.7-1.7)	9	0.5 (0.2-1.1)	130	0.9 (0.7-1.1)	76	0.8 (0.6-1.1)
Ever worked with pesticides –never SD or I*	23	1.0 (0.6-1.7)	12	0.9 (0.5-1.8)	109	1.1(0.9-1.3)	49	0.8 (0.6-1.1)

Anxiety - HAD score 8 –21
Depression - HAD score 8-21
PR adjusted for age group and area and mutually adjusted
Somatisation score could not be calculated for 50 subjects (out of 4339)
*SD = sheep dip, I= insecticides

5.4 Risk factors in users of sheep dip

Among agricultural workers who had ever used sheep dip, risk factors for three or more neuropsychiatric symptoms and for anxiety or depression were explored. Lifetime use of sheep dip was associated with an increased risk of reporting three or more and four or more neuropsychiatric symptoms for at least a good bit of the time during the previous month. The risk decreased after adjusting for somatising tendency, but there was still an increasing trend in symptom reporting with increasing use. The results also suggested a higher risk of depression in men who had used sheep dip for 50 days or more. There was a weak association between use of concentrate and neuropsychiatric symptoms, but no association with anxiety or depression (table 5.9).

The risk of current symptoms in sheep dip users who had reported acute symptoms (fever or chills, or four or more symptoms) after sheep dip use was compared with the risk of current symptoms in sheep dip users who had never had acute symptoms. The risk of three and four or more current neuropsychiatric symptoms and to a lesser extent the risk of anxiety and depression were increased in users who had reported fever and chills and in those who had four or more acute symptoms within 48 hours of use. Risks were reduced after adjusting for somatising tendency but, for current neuropsychiatric symptoms and depression, still remained high compared to the risk in those who had not reported any acute symptoms (table 5.9).

Table 5.9 Association between neuropsychiatric symptoms and sheep dip use

	≥ 3 current symptoms		≥ 4 current symptoms		Anxiety [a]		Depression [b]	
	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)	n	PR (95%CI)
Lifetime use of sheep dip (days)								
<10	15	1.0	7	1.0	88	1.0	46	1.0
		1.0[s]		1.0[s]		1.0[s]		1.0[s]
10-49	33	1.4 (0.8-2.7)	17	1.6 (0.7-4.0)	144	1.0 (0.8-1.3)	82	1.1 (0.8-1.6)
		1.4 (0.8-2.7)[s]		1.6 (0.7-4.0)[s]		1.0 (0.8-1.3)[s]		1.1 (0.8-1.6)[s]
50 or more	54	2.4 (1.4-4.4)	28	2.8 (1.2-6.5)	160	1.2 (0.9-1.6)	110	1.5 (1.0-2.1)
		1.8 (1.0-3.2)[s]		1.8 (0.8-4.3)[s]		1.1 (0.8-1.4)[s]		1.3 (0.9-1.9)[s]
Handled sheep dip concentrate								
No	27	1.0	11	1.0	123	1.0	74	1.0
		1.0[s]		1.0[s]		1.0[s]		1.0[s]
Yes	79	1.2 (0.8-1.8)	44	1.7 (0.9-3.3)	292	0.9 (0.7-1.1)	180	0.9 (0.7-1.2)
		1.1 (0.7-1.7)[s]		1.4 (0.7-2.8)[s]		0.9 (0.7-1.1)[s]		0.9 (0.7-1.2)[s]
Acute symptoms[c]								
Never	55	1.0	25	1.0	252	1.0	152	1.0
		1.0[s]		1.0[s]		1.0[s]		1.0[s]
Fever or chills	14	4.2 (2.3-7.6)	7	5.2 (2.2-12.4)	32	1.8 (1.2-2.5)	26	2.4 (1.5-3.6)
		2.2 (1.1-4.1)[s]		2.1 (0.8-5.3)[s]		1.1(0.7-1.6)[s]		1.6 (1.0-2.5)[s]
≥ 4 acute symptoms	30	5.2 (3.3-8.3)	16	6.7 (3.5-12.9)	56	2.0 (1.5-2.6)	46	2.6 (1.9-3.7)
		2.5 (1.5-4.1)[s]		2.8 (1.4-5.7)[s]		1.2 (0.9-1.6)[s]		1.6 (1.1-2.3)[s]

PR adjusted for age group (8 groups) and area
[s] PR adjusted for age group and area and somatising tendency (4 groups)
[a]Anxiety - HAD score 8 or more
[b]Depression - HAD score 8 or more
[c]Ever had symptoms within 48 hours of sheep dip use. ≥ 4 acute symptoms could include fever or chills. Each analysed separately relative to never having experienced acute symptoms.

5.5 Regional variations

Analyses were repeated for the whole population sample by areas, comparing pesticide users with non-users. There were some differences within categories of pesticide users by area for reporting three or four or more neuropsychiatric symptoms. Sheep dip users in Lincolnshire had the highest risk compared to non-users (PR 3.1 (95%CI 1.6-6.3) for four or more symptoms) whereas sheep dip users in the Welsh Borders did not have a higher risk (PR 1.0 (95%CI 0.6-1.7)). In Devon, men who had worked with insecticides but not sheep dip had the highest risk of all areas for this category of pesticide users (PR 2.0 (95%CI 1.0-4.0), compared men who had not used pesticides at work. Insecticide users from the Welsh Borders and Lincolnshire did not appear to be at an increased risk of four or more symptoms at least a good bit of the time in the previous month.

5.6 Summary of main findings

Neuropsychiatric symptoms were not uncommon and there was a suggestion of clustering of symptoms shown by higher than expected frequency of three or more symptoms. However, these findings were not specific to sheep dip users, or pesticide users. Pesticide users who had not used sheep dip or insecticides appeared to have a similar prevalence of single symptoms and be at a similar risk of multiple symptoms. These findings do not support the presence of a specific syndrome following exposure to sheep dip.

The tendency to somatise was strongly associated with reporting several neuropsychiatric symptoms and with anxiety and depression.

There was an association between reporting of current neuopsychiatric symptoms and amount of use and use of concentrate in sheep dip users. Men who had reported fever or chills or four or more acute symptoms following sheep dip use were at a higher risk of several current symptoms and anxiety or depression compared to users who had not had acute symptoms.

5.7 Strengths and limitations of the study

The study was large with a high number of respondents. Use of a community sample meant that we were able to compare outcome measures with workers who had not been exposed to specific categories of pesticide. This was valuable because many of the longer- term symptoms that had been reported to be associated with OP use are symptoms that occur commonly in the population anyway. A related strength of this study (over other studies that have addressed chronic symptoms that could be associated with use of OP sheep dip), was that we did not select subjects on the basis their current job, exposure or symptom history. The sampling frame for this study was all men aged between 25 and 69 years who lived within specified post code areas and the tables presented in this chapter include any man who reported ever working in farming, forestry or market gardening, thus reducing potential selection bias.

However because the response rate to the study was low, the possibility of self-selection relating to particular exposures and outcomes needs consideration, for example whether men who attributed all their symptoms to pesticide exposure were more likely to respond in large numbers. In the questions that were used to ascertain anxiety, depression and other neuropsychiatric symptoms, it was not obvious to subjects how their answers would be interpreted because the questions were quantitative (e.g asked to indicate how much they had suffered in the past month), the items we selected to use were "hidden" among others within a question, or the answers given contributed to a final score indicating degree of anxiety and depression.

This work sought to identify clinically relevant outcomes in relation to pesticide use i.e. symptoms actually experienced. Most of the outcome measures we used were current symptoms (past month or past week). While these could indicate chronic symptoms, they may not necessarily do so. An advantage of asking about current symptoms was that it should have minimised errors of recall.

Lack of specificity of exposure information was a shortcoming. In order to avoid complicating the question on exposure to pesticides at work, we did not ask about chemical names of pesticides used. Therefore we could not be certain that all sheep dips used were OPs (but it is likely that most were because of availability), though whether insecticides were OP or not was less clear. Men who reported acute symptoms after pesticide use were asked about chemicals used, but even for this subgroup, the information was not complete or precise enough to be useful.

5.8 Discussion

5.8.1 Frequency and risk of symptoms

Individual symptoms were quite common particularly tiredness and lack of energy. Most symptoms were more common in pesticide users than non-users, but this was not confined to sheep dip users. Similarly a marginally higher risk of several neuropsychiatric symptoms in pesticide users was not confined to sheep dip users, so our evidence does not support the existence of a syndrome specific to sheep dip.

Factors that may have influenced the level of symptom reporting, in the categories of pesticide use that we defined, include, definition of the exposure categories, reporting bias specific to particular categories and chance findings as well as actual variation or similarities.

The main group exposed to OPs were sheep dip users. Data on the number of days of use suggests that most users had at least moderate (more than ten days) exposure to sheep dip. However the exposure groups were heterogeneous. Sheep dip users in particular may have used any other type of pesticide, so estimated risks were not clearly associated with exposure stated in the category heading. Insecticide users were depleted of sheep dip users, so were reduced in number and may not have been representative of all users of insecticides. This may explain their apparent low risk of symptoms. However, the "other pesticide" user group that was similarly depleted did not have a low risk of symptoms. Our categories of exposure were based on the assumption that sheep dip use was the main determinant of symptoms. If another pesticide type were more important than sheep dip (which is unlikely based on previous evidence), then this would not be readily identified. Reporting bias between exposure categories was possible, but probably had a very small effect, if any. To some extent all pesticide users could have health concerns relating to their use of chemicals at work

The nature of chronic symptoms that have been attributed to OP pesticide use is quite diverse. This study focused on the more prominent ones that have been reported in the literature. Ascertainment of long-term symptoms ideally requires accurate information about time of onset and duration of symptoms. However to collect this information from a cross-sectional survey is difficult so we used mainly current symptoms (previous week or month) and ever seen a GP for symptoms (since pesticide exposure). Other studies that have relied on self-reported outcomes have used ever or current symptoms as we did, for example, "the following questions apply to the last 10 years" ,[33] "since becoming ill…",[33] or asked about the occurrence of various symptoms on a scale from not at all to extremely.[53]

Many studies have used more objective tests to measure outcomes, for example specific (current) neurophysiological [46, 57, 62] and biochemical measures.[41, 321, 322] These tend to assess sub-clinical effects and the clinical relevance of these measures is unclear. It would be difficult and costly to include as many subjects as we did if tests had been introduced.

Individual symptoms

Of the specific neuropsychiatric symptoms considered, tiredness and lack of energy was the most common in the population generally and in each exposure category, but most frequent in sheep dip users. Limited evidence suggests a possible association between OP use and chronic fatigue. In a population of mainly sheep farmers who had reported pesticide related ill-health to the Veterinary Medicines Directorate (VMD) under their Suspected Adverse Reaction Surveillance Scheme, higher chronic fatigue scores were associated with higher exposure to organophosphate pesticides. The chronic fatigue score was based on 23 questions which included a subset of eight on subjective fatigue, five on low concentration, four on poor motivation and three on lack of physical activity.[34] However the study results may have been influenced by bias as the population were a self-selected group and the response rate was only 37%.

Possibly a more plausible reason for tiredness and lack of energy could be the type and intensity of work undertaken. One argument against using non-farmers as a comparator group has been the difference in nature of work and factors besides pesticide use that could affect symptoms.[323] Even among the subjects in the analyses presented, who had all worked in agriculture at some time, there may have been differences in the nature of work done between groups of pesticide users and non-users that could have influenced tiredness and fatigue. The type of pesticide used could even act as a proxy measure for type of work done. Psychological factors might also have had a role, and in this part of the analysis age had not been adjusted for.

Other individual neuropsychiatric symptoms that were relatively frequent in sheep dip or other pesticide users were sensitivity to smells and difficulty remembering. There is little information specifically on sensitivity to smells, but some evidence suggests difficulty remembering follows acute poisoning[39] or self reported pesticide related illness.[53] These studies either asked subjects about difficulty remembering[53] or used memory tests.[39]

There was little difference in the prevalence or risk of depression across exposure groups. However, among sheep dip users there appeared to be an increased risk of depression in men who had experienced four or more acute symptoms or fever and chills. There was also an increased risk among high users. These risks decreased after adjusting for somatisation but remained significant in subjects who had reported acute symptoms.

There is limited evidence supporting an association between depression and OP use. In a cross-sectional survey of farmers and their spouses in Colorado who were exposed to pesticides, high depressive symptoms were associated with self-reported symptoms of poisoning in the past. However, the acute symptoms most strongly associated with depression were eye and skin irritation and chest discomfort and pesticides used included triazines, carbamates as well as OPs, although the most significant findings related to OPs.[42]

Before adjusting for somatising tendency we found an increased risk of anxiety in sheep dip users who had experienced acute symptoms. One study has suggested some increase in measured anxiety in commercial fruit sprayers who had recently been exposed to OPs, but not in farmers.[322] Anxiety is among the chronic symptoms attributed to OPs by individuals[18] but there is little information on its importance or association with other symptoms.

Multiple symptoms

There were clear differences between our study findings on multiple neuropsychiatric symptoms and those from a survey of farmers in SW England identified through Yellow Pages.[33]

In our study, there were no major differences in symptom reporting between exposure categories. Of the men who had ever worked with sheep dip, 5.6% had three or more symptoms, and 4.0% of never pesticide users had at least three out of seven symptoms. The proportion in those who had worked with insecticides but not sheep dip was similar to sheep dip users (5.3%), and in other pesticide users the proportion was 4.1%.

In the 175 farmers, from Cornwall and West Devon who responded to a questionnaire asking direct questions about OP exposure and key symptoms of COPIND in the previous 10 years, there was a significant difference between symptom reporting in the exposed (130 respondents) and non-exposed groups (45 respondents). Out of the eight proposed COPIND symptoms that were not related directly to experience of organophosphates (see table 5.1), 40.8% of the exposed group reported three to eight symptoms whereas 4.4% of the unexposed group experienced three or more symptoms.[33]

The proportions in the two studies are not strictly comparable. They relate to a similar group of symptoms, though questions were worded differently. The most probable explanation for high proportion of multiple symptoms in OP users is that the Cornwall/Devon study asked about symptoms in the previous 10 years, whereas our subjects were asked about symptoms in the past month and we included only those that occurred for at least a good bit of the time. However this does not explain the difference between exposed and non-exposed groups.

The difference between the exposed and not exposed groups in the Cornwall/Devon study, was statistically significant (p=0.0001), but numbers in the unexposed group were small. Response bias may have accounted for some of the difference (response to the Cornwall/Devon study, was 45%), but could not account for all. The potential for response bias may have been higher than in our study as the purpose of the enquiry and focus on OP pesticides was advertised, rather than disguised.

Exposure in the two studies was assessed differently. We did not define organophosphate exposure precisely in our subjects, though most sheep dip users and many insecticide users would have used organophosphates. We also included lifetime exposure to sheep dip, rather than just the previous ten years, but most of our subjects were exposed recently. If OP exposure was the main cause of symptoms then these factors would have reduced the observed effect in the sheep dip group further.

Another finding in our study was some effect modification by area, in that Lincolnshire sheep dip users appeared to be the most likely to complain. If our assumption that there has been less publicity about potential adverse effects of OP pesticide in Lincolnshire than in Devon was correct, this finding would be inconsistent with the view that publicity about possible adverse effects increases symptom reporting. The explanation for the differences by area, and the absence of association in the Welsh Borders is uncertain, but they may be attributable, at least in part, to chance.

5.8.2 Risk factors in users of sheep dip

The most important risk factors in sheep dip users were previous acute symptoms and amount of exposure.

Previous acute symptoms

The acute symptoms used were selected as a proxy for symptoms that have been proposed as indicators of a chronic disorder.[33] "Fever or chills" were used as a proxy for dippers flu, and four or more acute symptoms from the list of twelve in question 40 as a proxy for extreme sensitivity to OPs.

There is reasonable evidence to suggest that chronic symptoms are more likely to occur after an episode of acute OP poisoning.[18, 58] Most of the evidence of chronic effects has been based on neuropsychiatric tests and poisoned subjects identified from hospital admission data.[36, 40, 41] It is not clear from these studies if acute adverse effects of a less serious nature (that did not precipitate a visit to hospital) also increased the risk of longer-term symptoms. We did not ask about seriousness of acute symptoms in our study, but given that symptoms were common and hospital admission for pesticide poisoning is rare, it seems reasonable to assume that most were not of a serious nature.

The results of a cross sectional study of Colorado farmers suggested that some acute pesticide–related symptoms were associated with an increase in current (possibly long-term) symptoms.[53] The study set out to assess factors affecting neurological and other symptoms in pesticide users. The researchers included previous pesticide related illness as a potential risk factor. They asked whether the subject had become ill, sought medical treatment for the illness or been diagnosed as having pesticide poisoning, but these three definitions were not distinguished in the analysis nor illnesses described. Analyses included 761 farm residents. Most of the 22 symptoms asked about were more common in the 69 subjects who reported a previous pesticide related illness and for eleven symptoms the odds ratio was significantly greater than one. The significantly increased symptoms included, trouble remembering things, feeling depressed, heart palpitations, sleeping more than usual and numbness and tingling lasting more than a day. The results presented did not distinguish pesticide type but it was commented that using an OP rather than another pesticide was significantly associated with having a pesticide related illness.

The same study also reported high depressive symptoms (assessed using Centre for Epidemiological Studies-Depression (CES-D) scale) associated with self –reported poisoning symptoms.[42] The acute symptoms that were associated with significantly increased odds ratios for depression in OP users were eye irritation and chest discomfort. These symptoms were not included in our questionnaire.

The cause of any association between acute and longer-term symptoms remains unclear. It is difficult to untangle the effect of awareness of possible adverse effects in subjects who had reported acute symptoms and possible toxicological effects, particularly in the cases of less severe acute symptoms, where toxicity was less clearly the cause of short term effects. The use of objective exposure and outcome measures could, in theory, overcome this. Such studies have been done as discussed in section 2.1.[36-41] They only included subjects with hospital or physician diagnosed OP poisoning and used neuropsychological tests to measure specific outcomes. The results of these studies were not entirely consistent and the link between test results and symptoms experienced is also unclear.

Amount of Exposure

Amount of use is a reasonable measure of exposure. A UK study, using measurement of urinary metabolites of diazinon, has shown that the principal source of exposure to OPs was handling of concentrate dip. Exposure to dilute dip through splashing was also important and in a subsequent epidemiological study, using modelling techniques the authors found that cumulative exposure to sheep dip was highly correlated with the total number of dipping days.[21]

In this study a high number of days of use of sheep dip appeared to be a significant risk factor for neuropsychiatric symptoms. Use of concentrate also appeared to be a risk factor. The results suggest that cumulative exposure to sheep dip may be a risk factor for longer term symptoms.

Other studies have indicated that lifetime exposure may be associated with symptoms. A study of South African farm workers estimated lifetime exposure to OP pesticides using job exposure matrices (cumulative lifetime exposure and average intensity of exposure were calculated based on self-reported details of use by jobs, tasks, type of farming etc.). It was found that cumulative lifetime exposure to OP was significantly associated with erythrocyte cholinesterase concentrations.[324] However, long-term symptoms in relation to lifetime exposure were not assessed. [58] A study of licensed pesticide applicators in Iowa, measured pesticide-related visits to health care providers as an outcome.[325] (Acute and chronic symptoms were not distinguished). No sheep dip use was reported in this study population but use of insecticides, herbicides, fungicides and fumigants was recorded. Two significant risk factors for pesticide-related medical visits were personally mixing pesticides and high insecticide use (>70 applications). Moderate insecticide use (25-70 applications) was also a significant risk factor, but less than high use. The chemical nature of insecticides used was not mentioned. A Scottish study looking specifically at chronic fatigue and pesticide use also suggested a positive relationship between amount of exposure and symptoms.[34]

5.8.3 Influence of somatisating tendency

The association between symptoms and somatisating tendency was very strong. The high PRs and steep dose response effect shown in table 5.6 are unlikely to be due to undetected confounding or response bias. The issue is whether the associations are artificial as a consequence of overlap of exposure and outcome. Another concern is that reporting bias may have contributed if men were aware of the symptoms proposed to arise from acute and chronic pesticide poisoning, and if some of these mimicked somatisation. Removal of two neuropsychiatric symptoms from the score (feeling weak in parts of your body and numbness and tingling in parts of your body) should have reduced the probability that the score was artificially measuring a neurological symptoms. However most other symptoms used in the somatising tendency score, (faintness or dizziness, pains in heart or chest, nausea or upset stomach, trouble getting your breath) are among symptoms and signs that have been reported by individuals who believe that exposure to OP pesticides contributed to their long-term ill health.[18, 53]. Although there was no precise overlap between the symptoms we asked about and those from which the somatising tendency score was derived, it is possible that subjects who suffered from neuropsychiatric/psychological type symptoms also tended to have other symptoms with an elusive pathology. Whether this was primarily due to somatising tendency or caused by OP or other pesticide exposure is difficult to untangle, and cannot be ascertained from this study.

There is emerging data to suggest that a tendency to somatise can predispose to incapacitating symptoms. A longitudinal study of upper limb pain has shown that baseline levels of somatising tendency were a strong predictor of new onset disabling and chronic pain and a predictor of non-recovery in those with pain at baseline.[319] However the diverse nature of symptoms that have been attributed to OP exposure makes it very difficult to distinguish personality trait and exposure effects. Epidemiological evidence based on self reports can provide indicators but would benefit from objective corroboration given the diverse physical symptoms that can occur and their similarity to anxiety states and psychological problems. In sheep dip users there was still a residual excess risk of symptoms after adjusting for somatising tendency, suggesting that even if this personality factor is a prime influence on symptom reporting, there are possibly other factors, such as toxicity of pesticides used, nature of work or local environmental effects such as publicity through peers and the media.

5.9 Conclusion

Overall sheep dip users did not appear to be at an obviously higher risk of neurological and psychiatric symptoms than other pesticide users or non-users, though there was a tendency for pesticide users to report more symptoms.

We found no evidence to support the presence of a neuropsychiatric syndrome occurring specifically in association with sheep dip or insecticide use.

Among sheep dip users, the risk of multiple symptoms was associated with higher lifetime use. This apparent cumulative effect indicates that a toxicological mechanism cannot be ruled out. However, the strong association with somatising tendency suggests that psychological factors may play an important role. Further research to identify susceptible subgroups should take account of genetic and environmental factors including exposure to pesticide and publicity and personal characteristics.

There is insufficient evidence of a specific adverse effect to warrant any further change in regulation and use of licensed pesticides. However, personal efforts to minimise exposure during use of all pesticides at work should be encouraged. Use of PPE is limited in many UK farmers,[21] but adequate use has been shown to reduce exposure. [321]

CHAPTER 6: ACCIDENTAL INJURY

6.1 Introduction

As discussed in Chapter 2, there are many hazards associated with agricultural work and the frequency of accidents is high compared with most other occupations. It is important to be able to identify the most important hazards so that accident prevention programmes can be targeted appropriately. The most comprehensive source of information on occupational accidents occurring in Great Britain is from accidents reported through Reporting of Injuries Diseases and Dangerous Occurrences Regulations (RIDDOR). The other main source of data is from the Labour Force Survey (LFS). This large, ongoing, cross-sectional survey of households in Great Britain includes a question about accidents in the previous 12 months. The LFS is useful for comparing accident rates by industry, but unlike reporting through RIDDOR, does not report information on types of injury or circumstances of injury. Estimated rates of non-fatal injury in agricultural workers, calculated from LFS and from RIDDOR data indicate the degree of under-reporting through RIDDOR. However, LFS figures are based on a small number of cases, with high associated error. Data available through RIDDOR are more detailed but may not provide an accurate picture of patterns and types of injury among farmers because of incomplete reporting of non-fatal injuries. Reporting of fatal injuries is likely to be complete but only a fraction of non-fatal injuries are reported. The most important causes of fatal injuries may not be the same as those that lead to non-fatal injuries, and the latter are far more common. There is little information on injuries that are not reported. In particular, data from Great Britain is limited, quite localised, has been collected over limited periods of time and in relation to injuries that required medical attention. Thus the representativeness of the surveys is questionable. Also injuries recorded in such surveys have been categorised in a variety of ways, making direct comparisons difficult.

Because of incomplete reporting, RIDDOR may be a limited tool for setting health and safety priorities for enforcement and prevention. If the scale of underreporting is small and the patterns and risk factors are the same as in the farming population in general, some comfort may be drawn. If not, alternative tools are needed such cross-sectional surveys of representative samples.

In this study, we aimed to collect data that was reasonably comparable to non-fatal accidents reported under RIDDOR (major injuries and those leading to more than three days off work), so that accidents in our sample could be compared with those officially reported. The data also allowed comparison of accidents occurring in agricultural jobs (farming, forestry and horticulture) with those in non-agricultural occupations.

Subjects were asked if they had ever had an accident at work that was bad enough to cause them to take three or more days off work. If they had, they were asked to provide information on the nature of the injury and circumstances (question 39, appendix 5).

Some reports of accidents were excluded from the analysis. These were in men who were not in employment when they had their accident (e.g. retired, unemployed, school boy), men who indicated they were not at work at the time of the injury, or when the problem for which they had time off work was a medical one although they had classed it as accidental. Also, reported injuries at work that were stated not to have caused time off work, and those apparently while in work, but outside the age range 14 to 64 years, were disregarded.

Occupations in which accidents occurred were coded as agricultural or non-agricultural jobs. The employment status of men working in agriculture was determined by linking the age at which the accident occurred to information about agricultural jobs listed in responses to an earlier question (question 10). Employment status could not be ascertained in some subjects because the age at which the accident occurred did not match a job (within 5 years) or the age fell within the time period of two or more overlapping jobs including both an employed and a self-employed job. If the age at which the accident occurred was unknown, employment status at the time could only be assigned if it was the same in all agricultural jobs ever held.

The circumstances leading to each accident reported were coded into categories detailed in the reference table 'Accident – Kind (post April 2001) from the HSE's FOCUS data handbook. These categories have been used in HSE statistics reporting accidental injuries in farming, forestry and horticulture.[100, 107, 108]

6.2 Frequency of accidental injury

Of the 10,765 subjects who answered the questionnaire, 3527 answered 'yes' to ever having had an accident at work that caused an absence of three days or more. Of these, 227 men provided no information about their accidents, so they could not be included in the analysis and a further 67 were excluded because all accidents were invalid based on the criteria described above. This left 3233 subjects (30% of the whole sample) who reported having at least one accident at work. Between them, these subjects described 4897 valid accidents causing an absence of three days or more, including 1739 (35.5%) which occurred in agricultural jobs. The prevalence was no higher in men who responded to the initial mailing (30% of 7810 first time responders) than in those who responded after a reminder (31% of 2955).

Of the injuries occurring in agricultural jobs, 593 (38%) occurred while the subject was an employee and 900 (57%) while self-employed.

6.3 Types of Injury

The frequencies of various types of injuries reported for 4914 accidents are shown in table 6.1. For some accidental events more than one type of injury was reported. The relative frequency of types of injury was similar in non-agricultural and agricultural jobs, and in employed and self-employed agricultural workers.

Fractures, back injuries and cuts needing stitches were the most frequent types of injury in all groups and occurred at similar frequencies. Back injuries were the most common in non-agricultural jobs but cuts needing stitches and fractures were slightly more common in agricultural work.

Table 6.1 Types of injury occurring by job type

Injury type	Any job	Non-Ag. work	Agricultural work	Self-employed Ag. work	Employed Ag. work
Back Injury	1259 (25.6%)	871 (27.7%)	381 (21.9%)	192 (21.3%)	134 (22.6%)
Cut needing stitches	1102 (22.4%)	648 (20.6%)	446 (25.6%)	202 (22.4%)	165 (27.8%)
Fracture	1070 (21.8%)	648 (20.6%)	419 (24.1%)	233 (25.9%)	138 (23.3%)
Other sprain	500 (10.2%)	340 (10.8%)	156 (9.0%)	83 (9.2%)	53 (8.9%)
Head Injury	370 (7.5%)	263 (8.4%)	104 (6.0%)	59 (6.6%)	33 (5.6%)
Eye Injury	296 (6.0%)	209 (6.7%)	85 (4.9%)	42 (4.7%)	26 (4.4%)
Burn or scald	127 (2.6%)	107 (3.4%)	18 (1.0%)	11 (1.2%)	4 (0.7%)
Amputation	106 (2.2%)	59 (1.9%)	46 (2.6%)	24 (2.7%)	10 (1.7%)
Other	752 (15.3%)	490 (15.6%)	261 (15.0%)	151 (16.8%)	88 (14.8%)
Unknown	74 (1.5%)	36 (1.1%)	35 (2.0%)	21 (2.3%)	11 (1.9%)
Total accidents	4914 (100%)	3142 (100%)	1740 (100%)	900 (100%)	593 (100%)

Some accidents resulted in more than one type of injury
Agricultural and non-agricultural columns exclude details of accidents where information on occupation was missing
Employment status could not be determined in 145 agricultural workers

6.4 Multiple accidents

Some subjects reported several accidents at work, requiring time off. Table 6.2 shows the distribution of number of accidents reported in all subjects and in agricultural jobs. (145 agricultural workers were not included in the employed/self-employed sub-analysis because their employment status could not be ascertained).

Most subjects reported only one accident. Three subjects reported more than five valid accidents. The proportion of men reporting one to five accidents in each of the categories shown was quite similar. In both agricultural and non-agricultural jobs just over 11% reported three, four or five accidents.

Some subjects fell into more than one subcategory, for example a man reporting two accidents in an agricultural job may have had one as a self-employed worker and one as an employed worker, hence the proportion of single accidents appear higher in these categories.

Table 6.2 Number and percentage of subjects reporting 1 to 5 accidents according to job type

Number of accidents reported	Any job n=3233	Non Ag. work n=2160	Agricultural work n=1182	Self-employed Ag work n=627	Employed Ag work n=428
1	2211 (68.4%)	1544 (71.5%)	826 (69.9%)	444 (70.8%)	319 (74.5%)
2	604 (18.7%)	377 (17.5%)	222 (18.8%)	122 (19.5%)	69 (16.1%)
3	252 (7.8%)	141 (6.5%)	86 (7.3%)	41 (6.5%)	28 (6.5%)
4	108 (3.3%)	71 (3.3%)	29 (2.5%)	11 (1.8%)	8 (1.9%)
5 +	58 (1.8%)	27 (1.3%)	19 (1.6%)	9 (1.4%)	4 (0.9%)

n= number of subjects

Only the accidents described as individual events have been included in table 6.2. A further 55 subjects provided summary data indicating that they had had a certain type of injury 'many times' in the same job, or listed multiple circumstances and injuries in a job, without indicating which went with which or providing ages for individual incidents. These data were counted as single accidents and the first circumstance listed was coded. In some of these instances the question may have been misunderstood. It is possible that not all of the incidents led to the subject having 3 or more days off work.

Of the 55 subjects who indicated multiple accidents in this way, one third (18) were agricultural workers. The others were from a variety of occupations but included several fitters, construction workers, slaughtermen, police officers and fire fighters. The most frequent repeated injury reported was cut requiring stitches (26 including 7 agricultural workers). The other more frequent repeated injuries were back injury (16 including 8 agricultural workers), fracture (11 including 3 agricultural workers), sprain (8 including 2 agricultural workers) and eye injury (7 including no agricultural workers).

6.5 Circumstances leading to Injury

Circumstances leading to injury were coded into the categories shown in table 6.3. Handling incidents were the most frequent cause of injury overall, though among self-employed agricultural workers, fall from a height accounted for a higher proportion of injuries. Being injured by an animal was mainly confined to agricultural work and was most frequent in self-employed men.

A proportion of subjects reported several distinct accidents, as shown in table 6.2, and in some of these, the circumstances leading to the accident were similar on more than one occasion. Table 6.4 shows the proportion of subjects who reported an injury due to a given circumstance at least twice. The most common repeated injuries reported were related to manual handling. Among self–employed agricultural workers being injured by an animal and falling from a height were important causes of repeated accidents. Among employed agricultural workers, almost one in eight men who were hit by a moving, flying or falling object, were hit more than once. In certain non-agricultural occupations (mainly policemen), physical assault was a common cause of repeated injury.

Table 6.3 Circumstances leading to accidental injury according to job type

	Any job	Non Ag. work	Agricultural work	Self-employed Ag work	Employed Ag work
Injured while handling, lifting or carrying	1101 (22.5%)	777 (24.7%)	320 (18.4%)	143 (15.9%)	141 (23.8%)
Fell from a height	781 (15.9%)	519 (16.5%)	262 (15.1%)	159 (17.7%)	70 (11.8%)
Hit by a moving, flying or falling object	661 (13.5%)	427 (13.6%)	232 (13.3%)	103 (11.4%)	98 (16.5%)
Contact with moving machinery or material being machined	481 (9.8%)	246 (7.8%)	233 (13.4%)	126 (14.0%)	78 (13.2%)
Slipped tripped or fell at same level	439 (9.0%)	291 (9.3%)	146 (8.4%)	72 (8.0%)	57 (9.6%)
Hit by something fixed or stationary	353 (7.2%)	260 (8.3%)	93 (5.3%)	49 (5.4%)	37 (6.2%)
Injured by an animal	179 (3.7%)	23 (0.7%)	155 (8.9%)	97 (10.8%)	44 (7.4%)
Exposure or contact with a hot or harmful substance	113 (2.3%)	91 (2.9%)	22 (1.3%)	11 (1.2%)	7 (1.2%)
Physically assaulted by a person	97 (2.0%)	96 (3.1%)	1 (0.1%)	1 (0.1%)	0 (0.0%)
Hit by a moving vehicle	76 (1.6%)	48 (1.5%)	27 (1.6%)	14 (1.6%)	9 (1.5%)
Trapped by something collapsing or overturning	57 (1.2%)	43 (1.4%)	14 (0.8%)	8 (0.9%)	3 (0.5%)
Exposed to fire	25 (0.5%)	22 (0.7%)	3 (0.2%)	1 (0.1%)	0 (0.0%)
Exposed to explosion	22 (0.4%)	20 (0.6%)	2 (0.1%)	0 (0.0%)	1 (0.2%)
Contact with electricity or electrical discharge	16 (0.3%)	14 (0.4%)	2 (0.1%)	2 (0.2%)	0 (0.0%)
Another kind of accident	38 (0.8%)	31 (1.0%)	7 (0.4%)	4 (0.4%)	2 (0.3%)
Circumstance not given	458 (9.4%)	232 (7.4%)	220 (12.7%)	110 (12.2%)	46 (7.8%)
Total accidents	4 897 (100%)	3140 (100%)	1739 (100%)	900 (100%)	593 (100%)

Subjects not included because of missing information as indicated below:
9 subjects (18 accidents) could not be coded to agricultural job or non-agricultural job
In 246 accidents, 154 subjects could not be assigned an employment status

Table 6.4 Proportion of subjects reporting multiple accidents due to similar circumstances within types of job

	Any job		Non-agricultural job		Agricultural work		Self-employed Ag work		Employed Ag work	
	n	≥ 2 accidents	n	≥ 2 accidents	n	≥ 2 accidents	n	≥ 2 accidents	n	≥ 2 accidents
Injured while handling, lifting or carrying	911	143 (15.7%)	646	97 (15.0%)	280	32 (11.4%)	128	14 (10.9%)	125	12 (9.6%)
Fell from a height	719	54 (7.5%)	484	29 (6.0%)	239	22 (9.2%)	144	15 (10.4%)	64	5 (7.8%)
Hit by a moving, flying or falling object	583	69 (11.8%)	374	46 (12.3%)	212	18 (8.5%)	96	7 (7.3%)	85	11 (12.9%)
Contact with moving machinery or material being machined	471	54 (11.5%)	230	13 (5.7%)	216	16 (7.4%)	118	7 (5.9%)	72	6 (8.3%)
Slipped tripped or fell at same level	412	25 (6.1%)	271	19 (7.0%)	140	5 (3.6%)	69	3 (4.3%)	55	1 (1.8%)
Hit by something fixed or stationary	330	22 (6.7%)	242	17 (7.0%)	88	5 (5.7%)	48	1 (2.1%)	34	3 (8.8%)
Injured by an animal	155	19 (12.3%)	21	2 (9.5%)	134	16 (11.9%)	80	13 (16.3%)	41	3 (7.3%)
Exposure or contact with a hot or harmful substance	104	8 (7.4%)	82	8 (9.8%)	22	0 (0.0%)	11	0 (0.0%)	7	0 (0.0%)
Physically assaulted by a person	72	16 (22.2%)	71	16 (22.5%)	1	0 (0.0%)	1	0 (0.0%)	0	0 (0.0%)

n=number of subjects reporting each circumstance

6.6 Factors affecting accidental injury at work

Among agricultural workers the risk of accidents according to age, calendar period, time since in job, employment status and type of farming was estimated using a person-years approach and Poisson regression model. The five sets of variables used in the model were those that *a priori* were identified as potentially relevant and on which I had information.

Person years at risk were estimated from information provided in question 10 on jobs held in farming, forestry or market gardening. Jobs with a missing start age were excluded and those with a blank finish age were assumed to be current at the time of the questionnaire and were imputed with the subject's age at that time. Jobs were censored at ages 14 and 64 and at September 2003. For calendar year calculations, the job start and finish dates were based on mid-year ages (i.e. date for a start age of 20 was taken as the year in which the subject was 20.5 years). The calculations also took into account overlapping job ages so that person-years were not double counted. The data provided 98,687 person years at risk.

Only valid accidents occurring in an agricultural job with information on age and circumstances of accident were used in the analysis. This left 1492 accidents. As in analyses reported earlier in this chapter, agricultural accidents could only be linked to agricultural jobs where job ages spanned the age an accident occurred. In a few cases employment status could not be determined because of missing information or overlapping jobs with different employment status.

The risk of having an accident was higher at younger ages and during more recent time periods for all accidents combined (table 6.5). However in sub-analyses of types of accident by circumstance, this age pattern was not apparent except for injuries resulting from being hit by a moving, falling or flying object. Agricultural experience also appeared to be an important independent risk factor, particularly during the first year, but significant up to five years for all accident types combined (table 6.5). A relatively high risk in the first year of agricultural work was found for all accident circumstances included in the sub-analyses.

Table 6.5 Risk of accidents in agricultural workers by age and calendar period

	Number of accidents (%)	Accident rate per 1000 person years	IRR #(95% CI)	
Total	1492 (100%)	15.1		
Age Group				
14-19	162 (11%)	13.4	1.0	-
20-24	221 (15%)	15.3	1.5	(1.2 –2.0)
25-29	240 (16%)	17.1	1.6	(1.2 –2.2)
30-34	219 (15%)	16.6	1.5	(1.1 –2.0)
35-39	169 (11%)	14.1	1.1	(0.8-1.6)
40-44	166 (11%)	15.8	1.5	(1.1 –2.0)
45-49	116 (8%)	13.4	1.1	(0.9-1.8)
50-54	106 (7%)	15.5	1.4	(1.0 –2.0)
55-59	64 (4%)	13.5	1.1	(0.8-1.7)
60-64	29 (2%)	13.0	1.1	(0.6-1.7)
Time since started work in agriculture				
Up to 1 year	116 (8%)	25.5	3.7	(2.7-5.1)
1-3 years	104 (7%)	12.9	1.8	(1.3-2.4)
3-5 years	102 (7%)	14.0	1.6	(1.2-2.2)
5-10 years	236 (16%)	14.5	1.3	(1.0-1.7)
10-15 years	236 (16%)	16.4	1.4	(1.0-1.8)
15-20 years	196 (13%)	15.7	1.3	(1.0-1.8)
20-25 year	165 (11%)	15.6	1.4	(1.1-1.8)
over 25 years	337 (23%)	13.4	1.0	-

Incidence rate ratios – mutually adjusted and adjusted for calendar period, employment status and type of farming

The analysis on all accident types showed an increasing trend in risk of injury with more recent time periods (table 6.6). This trend, since the 1940s, was apparent in some types of circumstance, (contact with moving machinery, lifting or handling injuries, and being injured by an animal) but not others (hit by flying object, vehicle or something stationary), although over a more recent time period, the risk of injuries following slips and trips and falls from a height also showed an increasing trend.

Employment status did not appear to have a significant effect overall, but in analyses by kind of accident, employed workers were 1.5 times as likely to report injuries following being hit by a flying object, slips and trips, and lifting and handling injuries, while falls from a height were less likely to be reported compared to the self-employed. Content of work affected the risk of most types of injury. Jobs involving forestry were at particularly high risk compared to jobs that did not include forestry, and those involving beef cattle and cereals were also at increased risk compared to jobs not including these activities (table 6.6). When accident rates in men who only did forestry were compared with those in workers who did other types of farming as well as forestry, the rates were very similar. In analyses of risk by kinds of accident, being involved in forestry work was the most significant risk factor for injuries resulting from contact with machinery (IRR 2.5), being hit by a moving object (IRR 2.4), being hit by a vehicle or hitting something stationary (IRR 2.1), being injured while handling, lifting or carrying (IRR 1.9) and slip, trip or fall at the same level (IRR 2.2). Working with cattle was a significant risk factor for being injured by an animal (IRR 3.8 for beef and 1.8 for dairy cattle). Beef cattle farming was also significantly associated with slips and trips (IRR 2.7). Cereal farming appeared to be associated particularly with manual handling injuries (IRR 1.5).

Table 6.6 **Risk of accidents in agricultural workers by work experience and job activities**

	Number of accidents (%)	Accident rate per 1000 person years	IRR #(95% CI)
Total	1492 (100%)	15.1	
Calendar period			
1947-54	11 (1%)	7.8	0.2 (0.1 – 0.4)
1955-59	35 (2%)	10.4	0.3 (0.2 –0.5)
1960-64	51 (3%)	9.1	0.3 (0.2 –0.4)
1965-69	86 (6%)	12.2	0.4 (0.3 –0.5)
1970-74	110 (7%)	12.9	0.4 (0.3 –0.6)
1975-79	159 (11%)	15.0	0.5 (0.4 –0.7)
1980-84	184 (12%)	14.6	0.5 (0.4 –0.7)
1985-89	213 (14%)	15.4	0.6 (0.5 –0.7)
1990-94	240 (16%)	16.9	0.7 (0.6 –0.9)
1995-99	242 (16%)	17.4	0.8 (0.6 –0.9)
2000-04	161 (11%)	21.3	1.0 -
Employment status			
Self-employed	890 (60%)	14.5	1.0 -
Employed	582 (39%)	16.1	1.2 (1.0-1.3)
Unknown or Both	20 (1%)	21.3	1.4 (0.9-2.1)
Type of farming			
Beef	1132 (76%)	16.1	1.3 (1.2-1.6)
Dairy	638 (43%)	15.2	1.0 (0.9-1.1)
Sheep	1078 (72%)	15.9	1.1 (1.0-2.3)
Pigs	547 (31%)	15.2	1.1 (0.9-1.2)
Poultry	398 (27%)	14.1	0.9 (0.8-1.0)
Cereals	819 (55%)	16.4	1.3 (1.1-1.4)
Vegetables	315 (21%)	15.3	1.0 (0.9-1.2)
Fruit	90 (6%)	17.4	1.1 (0.8-1.4)
Forestry	357 (24%)	22.6	1.7 (1.5-1.9)
Other	130 (9%)	13.7	0.9 (0.8-1.1)

Incident rate ratios – mutually adjusted and adjusted for time since started farming and age group

6.7 Comparison with reported accidents since 1986

To coincide with the period over which RIDDOR has been in operation only data on accidents that had occurred in agricultural workers since 1986 were used for comparison.

Data on accidents reported, through RIDDOR, was obtained from HSE annual reports, 'Fatal injuries in farming forestry and horticulture'.[99, 100] These each include summary data for the number of non-fatal accidents reported in employees and the self-employed over the previous ten to thirteen years.

Table 6.7 shows the distribution of injuries reported under RIDDOR since reporting began and the distribution of reported injuries between self-employed and employed agricultural workers in this study, (in 1578 subjects providing age of accident).

The relative proportion of self-employed and employed farmers reporting injuries in our data was quite different to that for non-fatal injuries reported through RIDDOR. In our data a much higher proportion of accidents were reported by self-employed men. During the time period coinciding with RIDDOR statistics, the ratios of numbers of accidents reported in self-employed compared to employed agricultural workers were 1.9 in this study and 0.1 in accidents reported under RIDDOR.

Exclusions because of missing age information did not influence this finding. Most of those excluded from this part of the analysis fell into the unknown employment status category. For all injuries reported, the ratio of injuries in the self-employed compared to the employed was 1.5 whether or not those who provided age information were included.

Table 6.7 Non-fatal Injuries in employed and self-employed agricultural workers

	RIDDOR 1986/87-2001/02 [99, 100]*	**This study Since June1986****	**This study All injuries reported****
Self-employed	2846 (8.7%)	533 (61.8%)	900 (57.0%)
Employed	29738 (91.3%)	283 (32.8%)	593 (37.6%)
Unknown**	-	47 (5.4%)	85 (5.4%)
Total	32584	863 (100%)	1578 (100%)

*These statistics are taken from tables of non-fatal injuries reported under RIDDOR, which include over –3 day injuries and major injuries
**In subjects providing age information

6.8 Comparison of accident rates with those reported since 1996 under RIDDOR

Using data provided by HSE rates of RIDDOR-reported non-fatal injury in employed and self-employed agricultural workers according to circumstances of injury for the period 1996/7 to 2002/3 were calculated. We compared these rates with those from our data, calculated using person years at risk as described in section 6.6 above.

No information was available on accidents by circumstance (kind of accident) for earlier than 1996/7. Therefore in order to make comparisons over the same time period only a subset of data from this study was included i.e. accidents reported in an agricultural job since 1996.

Agricultural labour force data from HSE that had been provided to them by ONS for each of the years 1996/7 to 2002/3 were used as denominators. While the number of accidents by sex was available from HSE, labour force information by sex was not available. Therefore rates for male workers alone could not be calculated. HSE do not publish information on non-fatal accidents by sex but information available to us suggested that most reported accidents occurred in men (84% since 1996/7) and probably most of the work force are male. (In the June 2000 agricultural census 7% of the agricultural workforce were female employees. Farmers wives were also included in the workforce but not enumerated separately from farmers).

Table 6.8 shows that in the rural health study, total accident rates and rates for most circumstances were similar in employees and the self-employed, though the numbers of subjects in individual categories were small. The most notable differences were a higher rate of time off for lifting and handling injuries in employees compared to the self-employed and a relatively low rate of falls from a height.

However the rate of accidents reported through RIDDOR was many times higher for employees than the self-employed for all types of accident. Furthermore when reported accident rates were compared to rates calculated using data from our rural health study, there were large differences, particularly for the self-employed, suggesting underreporting of all types of accidents.

Table 6.8 **Rate of non-fatal accidental injury at work (requiring at least three days off work) per 1000 person years at risk (approx April 1996 to April 2003.)**

Circumstances	All agricultural workers		Self-employed		Employed	
	This study rate♦(n)	RIDDOR rate♦(n)	This study rate♦ (n)	RIDDOR rate♦ (n)	This study rate♦ (n)	RIDDOR rate♦ (n)
Injured while handling, lifting or carrying	4.9 (70)	1.0 (3219)	4.2 (38)	0.04 (53)	6.2 (31)	1.7 (3166)
Fell from a height	4.6 (65)	0.6 (1834)	5.3 (49)	0.11 (46)	3.3 (16)	0.9 (1688)
Hit by a moving, flying or falling object	2.8 (39)	0.8 (2541)	2.3 (21)	0.15 (197)	3.4 (17)	1.2 (2344)
Contact with moving machinery or material being machined	2.9 (41)	0.4 (1352)	3.3 (30)	0.10 (141)	2.3 (11)	0.6 (1211)
Slipped tripped or fell at same level	2.6 (36)	0.8 (2512)	2.2 (19)	0.04 (48)	3.1 (15)	1.3 (2464)
Hit by something fixed or stationary	1.1 (15)	0.2 (674)	1.1 (10)	0.02 (23)	1.1 (5)	0.3 (651)
Injured by an animal	3.4 (47)	0.3 (1113)	3.5 (31)	0.06 (87)	3.4 (16)	0.5 (1026)
Exposure or contact with a hot or harmful substance	0.4 (5)	0.1 (341)	0.5 (4)	0.01 (15)	0.2 (1)	0.2 (326)
Hit by a moving vehicle	0.7 (9)	0.1 (455)	0.7 (6)	0.03 (46)	0.4 (2)	0.2 (409)
Another kind of accident*	0.5 (6)	0.2 (795)	0.2 (2)	0.05 (67)	0.9 (4)	0.4 (728)
No information	2.2 (30)	0.0 (49)	2.2 (20)	0.00 (4)	1.9 (9)	0.0 (45)
Total accidents	19.5 (363)	4.6 (14879)	18.9 (230)	0.6 (817)	20.2 (127)	7.4 (14062)

*another includes fire, electricity, explosion, physical assault, trapped by something collapsing or overturning and other kind of accident. (RIDDOR data also includes drowned – only 13 non-fatal cases)
♦rate= rate per 1000 person years
self-employed and employed categories exclude 26 subjects in whom employment status could not be ascertained in the rural health study.

There was some variation in relative rate of reporting by kinds of accident. Table 6.9 shows the incidence rate ratios for individual types of circumstance from our study compared to rates reported through RIDDOR. The results suggest that overall there was the greatest apparent underreporting for being injured by an animal, falls from a height and machinery related accidents. Among employees, animal related accidents showed the highest ratio, and the self-employed appeared to particularly underreport lifting and handling injuries, slips and trips and being hit by something fixed or stationary, and to a slightly lesser extent animal related injuries and falls from a height. Our study included a much higher proportion of injuries that could not be classified although the actual number in this category accounted for only 8% of all accidents in agricultural workers included in the analysis.

Table 6.9 Ratio of rate of reported injury by circumstance°, in self-employed, employed and all agricultural workers, reported in Health and Work in Rural Populations study and through RIDDOR 1996 to 2002.

Circumstances	All agricultural workers	Self-employed	Employed
Injured while handling, lifting or carrying	5.0	107.3	3.7
Fell from a height	8.2	49.1	3.7
Hit by a moving, flying or falling object	3.6	15.8	2.8
Contact with moving machinery or material being machined	7.0	31.7	3.6
Slipped tripped or fell at same level	3.4	62.0	2.4
Hit by something fixed or stationary	5.3	64.7	3.2
Injured by an animal	9.9	54.5	6.3
Exposure or contact with a hot or harmful substance	3.8	45.1	1.2
Hit by a moving vehicle	5.0	20.6	1.9
Another kind of accident*	2.0	4.0	2.3
No information	146.0	744.4	80.2
Total accidents	4.3	31.3	2.7

°Ratio calculated rate per 1000 PY in rural health study: rate per 1000 PY reported through RIDDOR
*includes injury by fire, electricity, explosion, physical assault, trapped by something collapsing or overturning and other kinds of accident.

6.9 Summary of main findings

Almost one third of respondents reported having at least one accident at work requiring three or more days off during their working lifetime. The accident rate in agricultural jobs was 15 per thousand person years at risk. The types of injuries occurred in similar proportions in agricultural and non-agricultural jobs. The most common types of injury were back injuries, cuts needing stitches and fractures. Repeated accidents were not uncommon. Over 11% of men, who reported at least one accident whilst working in agriculture, had three or more accidents in an agricultural job. The proportion for non-agricultural jobs was similar.

Injuries while handling, lifting or carrying were the most frequently mentioned kind of accident overall. Injuries from lifting or carrying resulting in three or more days off work accounted for a lower proportion of injuries in self- employed agricultural workers than in other groups. Being injured by an animal was largely confined to agricultural work and injuries through contact with machinery were relatively more frequent in agricultural jobs than non-agricultural jobs.

Among agricultural workers the risk of accidental injury was particularly high among men who had recently started working in agriculture and in those who undertook forestry.

The rate of accidents reported in our study was much higher than the rate of accidents reported through RIDDOR for comparable years, particularly for the self- employed. Some kinds of accident were particularly underreported especially lifting and handling injuries in the self-employed.

6.10 Strengths and limitations of the study

A strength of the study design was that it collected information from a community based sample of men and allowed us to compare numbers and types of accidents occurring in agricultural work with those in other jobs. The study was not designed to look at accidents in other types of job in detail.

Subjects were asked about ever having an accident in any job and this yielded a lot of data, almost 5000 accidents in total and over 1700 in agricultural work. Also because data was collected on job history we were able to look at accident rates.

Again, the low response rate to the questionnaire raises the potential for response bias. It was possible that men who did not answer the questionnaire had fewer injuries at work than responders, thus leading to an over estimation of the frequency of accidental injury. However the question on accidental injury was short and towards the end of the questionnaire, so it seems unlikely that subjects would have selectively responded for this reason. Also there was very little difference in the proportion of men who reported accidents in first and second time responders.

It is possible that men with current serious injuries were among the non-responders. However, if this was the case the numbers would be small and unlikely to be differential with respect to agricultural and non-agricultural injuries.

Over-reporting of accidents, for example accidents that did not occur at work or did not result in taking three or more days off work, may have occurred and if present, would tend to explain the higher rates in our study compared with RIDDOR. However, to account for the ratios in table 6.9, the scale of over-reporting would have had to be substantial (four fold overall) and differential (higher in the self-employed) if RIDDOR data are considered to be accurate.

If there was a clear indication that the accident recorded on the questionnaire did not occur at work or result in three or more days off it was not included in the analysis, but otherwise, we had to assume accuracy in reporting of work related accidents. Some types of accidents, mainly road traffic accidents, may not have all occurred whilst working, but these accounted for relatively few accidents. Vehicle accidents, involving passengers as victims, would have been coded as "hit by something fixed or stationary", according to guidance in the HSE's FOCUS data handbook. Only 8.3% of accidents in non-agricultural jobs were in this category. Road traffic accidents accounted for less than one third of these and many of these accidents clearly were whilst at work. Therefore if there was some over-reporting, it probably had little impact on the results.

In this study we asked about lifetime history of injuries. Lapses of memory over time may have led to underreporting of distant experiences (table 6.6 calendar period), but this was not our main interest. The analysis on all accident types showed an increasing trend in risk of injury with more recent time periods, as shown in table 6.5. However the fact that this did not apply to all circumstances suggests that the trend could not be accounted for by recall bias alone. Comparisons with HSE statistics were for more recent years therefore less prone to errors of recall, and although restricting the analysis in this way did reduce numbers, the differences observed, particularly for the self employed, were so large that it is not possible that they could be attributed to chance alone.

There was some missing information preventing us categorising accidents by circumstance or looking at risk factors in every subject. As the actual numbers with missing information were relatively low, the overall impact of this would have been small.

6.11 Discussion of results

6.11.1 Frequency and type of injury in agricultural workers

Our results suggest that the accident rate in agricultural workers was around 15 per 1000 person years for the whole sample, though higher (20/1000 person years) for accidents since 1996. The most frequent types of injury resulting in time off work were cuts needing stitches, fractures and back injury. Being injured while lifting, handling or carrying and falls from a height were the most frequent circumstances leading to accidental injuries. Manual handling injures were most common in employees and falls from a height were most common in the self-employed.

It is possible that the apparently higher injury rate for more recent years was an effect of recall bias. The rates we estimated for more recent years were compatible with other data. Two large surveys of accidental injury in United Kingdom have been reported in recent years, one in Wales[109] and one in Northern Ireland.[20] Both these surveys collected data over one year, included farmers and farm families in most of their statistics, and included any accidental injury. The study in mid Wales carried out in 1993/4, suggested an accident rate of 105 per 1000 per year in full time farmers aged 16-65 years, although 70% took no time off work. This suggests that approximately

30/1000/year took any time off work.[109] The injury rate for farmers and their families on Northern Ireland farms was 19 per1000 per year in the survey carried out in 2000/01,[20] similar to our estimate. A prospective survey of patients attending the central Accident and Emergency Department and Eye Casualty Department in Aberdeen over a period of 27 and 11 days respectively estimated an annual injury rate of 91 per 1000 employees (69 per 100 through A&E and 22 per 1000 through eye casualty) in agriculture forestry and fishing, The estimates used Census data to provide a denominator and assumed the period rate remained constant throughout the year[103]. There was no information on time off work in this study.

The classification of types of injury was different in the Irish and Welsh surveys, and both differed from the classification we used. Lacerations accounted for 38% of injures in both surveys and were the most common types of injury. Fractures were also common in the Irish study (32% of injuries),[20] though they featured less in the Welsh study (7% of injuries).[109] In the hospital based study, fractures were the most common type of injury followed by soft tissue injuries and lacerations.[103] The causes of accidents were classified in a way that was not comparable with our study.

The potential hazards in agricultural work are recognised. There is published safety guidance relating to most aspects of farm work including using machines safely, safe manual handling, farm forestry work, maintenance work including ladders and roof work and livestock handling.[326] The guidance is comprehensive in its approach but does not indicate the relative importance of safety precautions (for those who are not going to follow them all). However, there are occasionally specific safety campaigns and new regulations which focus on important problems such as falls from a height.[327]

The differences in accident rate between employees and self-employed agricultural workers were greatest for lifting and handling injuries and falls from a height. These differences could have occurred by chance. Another possible explanation is that type of work differs in employed and self-employed workers, thus influencing the risk of accidents, but this does not seem very likely. A more probable explanation is that self-employed farmers were less likely to take time of work for certain types of injury such as those not thought to require medical attention. This could include lifting and handling injuries to a greater extent than falls from a height.

It is recognized that while most farmers understand safety instructions they receive, they frequently continue to engage in risky behaviours, even if they are well aware of potential injury consequences. Safety behaviour is influenced by much broader beliefs and attitudes, including expected and traditional behaviours.[119] While there is some evidence that general safety education can reduce injury rates,[118] other data suggest that education programmes about safety are of questionable effectiveness because of other factors affecting risk perception.[115, 117, 119]

6.11.2 Comparison of type and circumstances of injury in agricultural and non-agricultural workers

Comparisons using proportions can be misleading if the percentages are distorted by a dominant or non-existent category within a group. However, the overall similarity in different types of injury in agricultural and non-agricultural jobs can be taken at face value. Also the proportion in each of these job categories who reported three or more accidents was the same. There was some difference in frequency of accident by circumstance or kind of accident. Being injured by an animal was largely confined to agricultural work and injuries through contact with machinery were relatively more frequent in agricultural than non-agricultural jobs. However injuries while handling, lifting or carrying were relatively more frequent in non-agricultural jobs as a proportion of the total accidents, and personal assault was rare in agricultural work. There was evidence of repeated accidents occurring due to similar circumstances in both agricultural and non-agricultural jobs, especially for the more common kinds of accident.

The comparative frequencies of types of injuries and circumstances that we observed are probably a true reflection of relative frequencies in our sample. There seems no obvious reason why men with accidental injury in agricultural jobs should respond differently to those taking time off in non-agricultural jobs. Non-agricultural jobs in this study were a diverse group including occupations at high risk (e.g. in construction) and lower risk (e.g. office workers) of accidents. They represented jobs that had been held by men who were living in a rural community at the time of the questionnaire, but probably did not represent the job distribution in the national population as a whole.

The differences in kinds of accident between agricultural and non- agricultural jobs partly reflected special aspects of agricultural work. Thus the difference in animal related injuries is unsurprising. However we only asked for information on injuries that resulted in taking three or more days off work. Therefore threshold for time off could be a factor that affected reported incidents. For example injuries caused by lifting, handling and carrying could reflect whether time was taken off work rather than the actual frequency of injury.

Severity of injury was not assessed. It is possible that in some occupations time was taken off for milder injuries. Factors influencing whether time was taken off for milder injuries could include employment status, type of work being undertaken, co-worker support and job satisfaction. Deficiencies in the latter two have been shown to influence time taken off work for back pain.[328]

Repeated accidents in similar circumstances suggest that while there may be some educational impact of having suffered an injury personally, it clearly did not lead to adequate caution in all individuals. Previous studies have shown that recognition of hazards is not necessarily associated with better risk management, though risk taking behaviour may be reduced.[117] Repeated accidents of a similar kind could be the result of frequent exposure, inadequate preventative measures, safety advice not being followed or sensible precautions not being taken.

We did not estimate comparative rates of injury, but agricultural work is a high risk occupation based on mortality statistics.[16] An analysis of work related injuries attending the central A&E department in Aberdeen suggested similar injury rates in construction, manufacturing and agriculture, forestry and fishing, each at least three times the rate of injuries occurring in service industries.[103] From the analyses presented we cannot say whether our study reflected this. We cannot tell, from the results of this study, the association between injury and exposure. Some exposures are more hazardous than others and some more common (such as manual handling). The relative numbers give an indication of public health importance rather than the individual attributable risk associated with different hazardous exposures.

6.11.3 Factors affecting frequency of injury in agricultural jobs

The risk of having an accident appeared to be higher at younger ages and during more recent time periods, though the latter could at least, in part, be an effect of recall bias. The highest rates of injury were in forestry work. The rates were similar in men who only did forestry work and in agricultural workers who did other types of farming as well as forestry. Beef cattle farmers were also at a relatively high risk of injury. Employment status did not have a significant effect on the overall risk of injury

Our measure of exposure to types of farming was not quantitative or precise. If the job in which the accident occurred included a certain type of agricultural work, then it was counted as a risk factor even though the accident may have occurred whilst doing something else. Most agricultural jobs included a variety of types of farming. Our definition of forestry for the analyses in this chapter included any agricultural job that involved some forestry so included general farmers as well as foresters. Despite this dilution of exposure, subjects whose jobs incorporated some forestry were at a higher risk of injury overall and for most of the types of accident circumstance that we analysed.

The association with work inexperience was probably a real effect, and not just an artefact of incomplete reporting by dissatisfied, short-term workers. Young age, less farm experience and large livestock have been identified as risk factors for farm accidents in other studies.[119, 120] Fewer years of farming experience was one factor associated with machinery-related injury in Iowa farmers, USA,[329] and for farm-work related injuries in New South Wales, Australia, young age and/or experience was a significant risk factor.[330] Other studies in Iowa, Alabama and Ontario have found that young age (less than around 40 where age was specified) was a risk factor for injury. [120 125, 331, 332] Inexperience has also been identified as a risk factor in other occupations. In French railway workers, among other factors, young age and lack of experience were associated with an increased risk of occupational injuries.[320] Also, first ever episodes of low back pain in young workers were most likely to develop during their first year of employment in a Belgian study and it was suggested that this may have reflected a lack of work experience or training.[333]

Forestry is recognised to be a high-risk occupation. In an analysis of mortality in agricultural workers in the UK during 1986/7 to 1991/2, death rates from injuries at work were higher in forestry than in other branches of agriculture, though it was noted that this difference could have occurred by chance because of deaths occurring in a workforce of fewer than 8000 foresters.[16] An analysis of work related mortality in New Zealand 1985-1994 did suggest significant differences in mortality rate. In loggers the rate (215/1000,000) was significantly higher than in crop or livestock farmers (92/100,000) although the latter group had a significantly higher risk than the whole group of market orientated agricultural and fishery workers (28/100,000). Forestry contractors were also at high risk (110/100,000), though forest hands less so (51/100,000).[334] There is less information on comparative morbidity in foresters, though accidents in loggers in the USA and some other countries have been the subject of several studies. Tree felling has been associated with most fatalities [335] and almost one third of non-fatal injuries were through being struck by a falling tree or limb.[336] A study from New Zealand found that fatigue was one factor associated with near miss injury events. The authors suggested that with the slim margin for error in forestry operations, an impairment due to increased fatigue may constitute a significant risk factor for accidental injuries.[337]

Mortality statistics and studies on accidents in foresters probably do not include farmers who do a variety of work including forestry. The fact that we found their risk of accidental injury to be similar may be a reflection of our imprecise measure of exposure or could suggest that the effects of exposure and experience balance out, i.e. full time foresters had a higher exposure to (high risk) forestry activities but were more likely to be experienced whereas farmer/foresters who spent less of their time doing forestry work may have taken fewer safety precautions.

In terms of numbers injured, forestry work appears to be less important than some other agricultural processes. HSE do not present numbers of non-fatal injuries by types of farming as we have categorised them but annual reports do give numbers of injuries reported by process and environment.[99, 100, 105-108] The definition of categories has gradually changed over the years since 1996, but the data on injuries does suggest that reported animal husbandry injuries were approximately five times as common as forestry /arboriculture related injuries over the time period 1996-2002. However, as denominators for these processes are not known, the risk of reported injuries is unclear.

6.11.4 Comparisons with accidents reported through RIDDOR

The estimated rate of accidents in agricultural jobs in our study was much higher than calculated rates of accidents reported to HSE or local authorities under RIDDOR, particularly for the self-employed. The difference we found supports the view that underreporting of non-fatal injuries at work is particularly prevalent among self-employed agricultural workers.

The calculation of accident rates relied on self-report of jobs held and accidents reported by subjects responding to the questionnaire. For the denominator we used person years of exposure to an agricultural job and this depended on completeness of occupational history reported in question 6. An underestimate of exposure would have increased the rates we estimated. However for this part of the analysis we only used employment information since 1996, and it is likely occupational history was most complete and accurate for more recent time periods. Similarly recall of accidents was likely to be most complete in this restricted calendar period.

For comparison of accidents by kind, data used were limited to accidents occurring since 1996 to correspond with data available from HSE. However, this did have the disadvantage of reducing the numbers in our sample, so introducing more scope for chance variation.

There were several differences in the data we collected and accidents reported under RIDDOR that could account for some of the inconsistency, but are unlikely to explain all.

The definition of accident we used was not identical to the HSE criteria for reporting. We asked about accidents at work that were bad enough to lead to three or more days off work. Reportable accidents occurring at work include accidents resulting in more than three days off work and major injuries which include most fractures, serious eye injuries, amputations and injuries requiring immediate medical attention. It is unlikely that the difference in definition had much impact on overall frequency, because most major injuries would have resulted in three or more days off, so be counted in our data, but those that did not could compensate for the difference between three days and more than three days off work. It is possible that some subjects reported accidents when they had not actually taken three or more days off work, but thought they deserved to.

Subjects who reported accidents but stated that they did not take time off were excluded from the analysis, but other information was taken at face value.

Our data included only males whereas injuries reported under RIDDOR include both males and females. The HSE reports on injuries in agriculture do not routinely publish data by sex and there was inadequate employment data to estimate rates separately for males and females. The difference in accident rates estimated for males alone compared to both sexes would be influenced by the accident rates in males and females individually and the proportions of males and females in the agricultural workforce.

In general being male is a risk factor for accidental injury, so it would be fair to postulate that including females in a sample would lower the overall accident rate. However this would only have a significant impact if there were a reasonable proportion of females working in agriculture.

The number of female workers is not well documented. The agricultural Census 2000 suggests that only 7% of the workforce were female employees. However, 56% of the labour force included farmers, farmers spouses, other farmers, partners and directors, so there may have been a substantial number of women in this group.

Data obtained from HSE, on numbers of reported accidents in males and females, suggests that since 1996/7, 16% of the non-fatal injuries that were reported occurred in females (17% for employed and 5% for self employed), implying a higher accident rate than in males, if females make up less than 16% of the workforce. It is conceivable that females were more likely to report accidents, in which case their inclusion would lessen the discrepancy between reported accidents and the rates observed through survey.

Overall, inclusion of females probably did not influence the rate of reported accidents substantially and could not account for the differences we observed between our rural health study and RIDDOR data.

We included an upper age limit of 64 years to reduce the inappropriate inclusion of accidents that were not work-related. There is no upper age limit to reporting under RIDDOR. This precaution may have led to an underestimate of accident rates in our study if the rate in the workforce aged over 65 years is high and there are large numbers in this group. In practice it probably had little impact.

Another possible contributing factor to the differences is that our data were not representative of the pattern of accidents occurring in Great Britain as whole. The majority of agricultural workers in our sample were from predominantly sheep farming areas and possibly over-represented self employed small farmers. However, even if this had been the case it would be difficult to explain such a huge discrepancy between the proportion of employed and self-employed agricultural workers reporting injuries.

Categorisation of accidents by circumstance/kind of accident used standard guidance provided by HSE. The accidents reported in our Rural Health Study were categorised by one person (CS) and checked by another (DC) for interpretation of guidance and internal consistency. It is possible there were minor differences in categorisation of some kinds of accident in our study and accidents reported under RIDDOR, but it is unlikely that there were major discrepancies. We did find that missing information on circumstances was more likely in our study, but this would not have impacted on the global difference in reporting observed.

The method of data collection would be expected to have the opposite, if any, effect on rates to that observed because of recall bias. If HSE and local authorities were informed of all reportable accidents, the rates could be higher than those observed in our study, because of the time lapse between accidents occurring and being reported.

Despite the above cautions the differences observed were too large to be explained purely by bias and differences in data collection and analysis.

The degree of under-reporting we estimated for self-employed agricultural workers (3% reported) was compatible with a LFS estimate of less than 5% reported in 1998/9.[102] An indication of underreporting is also suggested by RIDDOR data on fatal injuries. One might expect the proportions of non-fatal injuries in employed and self-employed would mirror fatal injuries, which are more completely reported. The relative proportions of fatal injuries in employed and self-employed agricultural workers, reported under RIDDOR (chapter 2, fig 2.3), were close to our findings for non-fatal injury reporting. This suggests that our data reflects the relative proportion of injuries that actually occurred in employed and self-employed workers.

There are several reasons why injuries may go unreported. In fact it would be surprising if all reportable accidents were notified, particularly if there was no perceived individual benefit. In other reporting schemes, such as notification of infectious disease, under-reporting (by GPs) is recognised.

There are a number of possible factors that may contribute to the difference observed between the relative frequency of injuries reported by self-employed and employed agricultural workers reported to HS/LA.

One factor is the perceived importance of the injury. Many farmers especially the self-employed or longer-term farmers may consider accidents as an accepted part of the job. Anecdotal discussion with farmers suggests that this may be so and could apply to common injuries such as from lifting and handling and animal related injuries, particularly in self-employed agricultural workers

Our data suggest that among the self-employed, injuries least likely to go unreported were being hit by a vehicle or being hit by a moving, flying or falling object. It is not possible to assess severity of injury based on these circumstances, but one factor contributing to perceived importance could be severity of injury. Summary data produced by HSE suggests a reporting bias towards major injuries in self-employed agricultural workers.[101] For the years 1991/2 to 2002/3, self-employed workers reported proportionately fewer over 3-day injuries compared to major injuries. The ratio of reported injuries from the self-employed compared to employed workers was 0.16 for major injuries (1027:6503 injuries reported) and 0.05 for over 3-day injuries (809:16443 injuries reported).

The onus to report injuries falls on the employer and not medical services (as in some other countries or for communicable disease). Ignorance of the reporting requirement, particularly in small businesses and among the self-employed may contribute to differential reporting. Also large employers may have systems and employ someone who knows of the legal obligation and can ensure that it gets done.

Perceived benefits or disincentives to reporting may also influence reporting rates. Responsibility to others and a fear of possible consequences of not reporting an injury may make an employer feel more obliged to report an injury to an employee than their own injury. Self-employed people may not feel inclined to report injuries that occurred because of carelessness or failure to implement safety measures or may be ignorant of the need or fearful of costly enforcement actions. There may also be a perception that nothing practical can be done for some types of injury such as slips and trips.

It is possible that for some injuries self-employed workers did not need to be completely off work more than 3 days following their injury, (as they could do some light or non-manual work) so the did not consider the injury reportable to HSE or local authorities at the time, but recalled the injury for our survey.

It is worth considering whether underreporting matters. A purpose of gathering information is to identify important causes of accidents in order to inform preventive measures. Also when preventive measures or advice are in place, routine monitoring should give an indication of effect. It would be unrealistic to expect all eligible accidents to be reported, but it is important to know the degree of underreporting, whether reporting patterns change with time (thus falsely influencing trends), and whether patterns of reporting differ with accident type. With this knowledge, more reliable assumptions can be drawn about the true rate of accidents.

This study has provided some information to inform this suggesting that underreporting does matter in this case as it highlights self employed agricultural workers as a target group with special needs who bypass the current systems. For example, based on these data, more effort should be directed than implied by RIDDOR figures on safety education and prevention in the self employed.

6.12 Conclusions

Accidents occurring at work over a period of time were common in both agricultural and non-agricultural jobs, and the most common circumstances leading to injury were similar in these two groups with the exception of some specific types such as animal related injuries in agricultural workers. The relative frequency of different types of injury was also similar.

As a prelude to intervention it is important to find out what training and advice is already being given. For example it is not clear what level of supervision, safety advice and support new workers receive or where the self-employed or those who lack a supervisor get their information and training. This information might be obtained through a cross-sectional survey.

The most significant risk factors for agricultural injury were forestry work and years of farming experience. Hazards of forestry work are recognised and advice on risks, personal protection and safe use of machinery is published, but it is not clear whether appropriate safety measures are applied by British workers nor what proportion of accidents could have been prevented by use of safety measures. A case control study of accidental injuries associated with forestry work might help to identify specific risk factors for different types of forestry related accident.

Our results are consistent with the recognised underreporting of work related accidents in agricultural workers, especially the self-employed. The degree of underreporting may be of even greater magnitude than estimated from LFS.

CHAPTER 7: MENTAL HEALTH PROBLEMS, MUSCULOSKELETAL DISORDERS AND OTHER HEALTH OUTCOMES

7.1 Introduction

As discussed in chapter 1, accidental injury is only one of a number of non-chemical hazards associated with agricultural work. The physical nature of this type of work is a risk factor for musculoskeletal complaints, but with the exception of hip osteoarthritis there has been relatively little work that has focussed specifically on farmers, and their risk in relation to other occupations is not very clear. Other conditions shown to be important in some groups of agricultural workers include dermatitis[277, 278, 338] respiratory diseases[210, 265, 339-341] and hearing loss,[186, 190, 192] but there is little information on how risk compares with other occupational groups. These conditions are not reportable under RIDDOR but they are through occupational reporting schemes (Occupational Disease Intelligence Network - ODIN), but in some occupations, including agriculture, access to occupational physicians is limited and consequently less illness tends to be reported through this route. Thus it is difficult to assess the relative risk for these outcomes compared to other occupations. For other conditions such as hernia and vibration white finger, in which there are reasons to believe that agriculture may be a high risk occupation there is insufficient evidence to know whether this is really the case.

Mental health is another area of concern for agricultural work and there have been some detailed studies particularly in relation to suicide (discussed in chapter 2.3). However the prevalence of clinical depression in agricultural workers compared to the general population is not clear owing to inconstencies in study results.

This chapter reports the frequency of a range of health outcomes that may be associated with work in agriculture and the relative risk of these outcomes in agricultural compared with non-agricultural work.

7.2 Mental Health problems

In order to assess current levels of anxiety and depression in subjects we used the HAD score. Anxiety and depression were scored separately and a score of eight or more indicated at least moderate anxiety or depression. Men were also asked if they had ever seen a GP, attended hospital or taken time off work for certain mental health symptoms. A positive response to any of these three was taken as an indicator of having suffered the respective symptom at some time. Using a modified Cox's proportional hazards model approach, prevalence ratios, adjusted for birth cohort, were estimated for each outcome in men who had worked in agriculture compared to men who had never worked in agriculture. For men who had ever worked in agricultural jobs we considered separately, those who had worked in agriculture for at least 10 years, those who started such work before the age of 30 and those who had worked in agriculture for at least 10 years and started before the age of 30.

Table 7.1 shows the proportions and prevalence ratios of specific outcomes in ever agricultural workers and those who had worked in agriculture for at least 10 years and started before the age of 30, compared to men who had never worked in agriculture. Prevalence ratios were adjusted for birth cohort. The results for intermediate groups i.e. all men working in agriculture for at least 10 years and all agricultural workers starting before the age of 30 were very similar to, or fell between those shown, so have not been included in table 7.1 or any of the following tables.

The presence of moderate depression or anxiety (HAD score 8 or more) was very similar in each of the categories of ever or never agricultural workers. The presence of moderate depression was perhaps marginally higher in men who had worked in agriculture but these men were least likely to have sought medical help or taken time off work for stress or mental illness. The prevalence ratio for going to a doctor or taking time off work was lowest for men who had worked in farming for longer.

When prevalence ratios were adjusted for level of alcohol intake and marital status, there was a marginal decrease in the risk of depression in both ever agricultural workers and those who worked in agriculture before the age of 30 and for longer than 10 years (PR 1.0), and in the risk of having sought medical attention or taken time off work for depression or irritability (PR 0.9), among ever agricultural workers. Otherwise, however, prevalence ratios were unaffected.

Table 7.1 Prevalence and risk of mental health associated symptoms in men who had worked in agriculture

	Agricultural work							
Symptoms	Never		Ever			Before age 30 + for at least 10 years		
	n	(%)	n	(%)	PR (95%CI)	n	(%)	PR (95%CI)
Stress/mental illness (GP, hosp. or time off)*	1007	(16.8%)	620	(13.0%)	0.8 (0.8-0.9)	249	(9.8%)	0.6 (0.6-0.7)
Fatigue (GP, hosp. or time off)*	663	(11.1%)	595	(12.5%)	1.1 (1.0-1.2)	280	(11.0%)	1.0 (0.9-1.1)
Depression/irritability (GP, hosp. or time off)*	542	(9.0%)	395	(8.3%)	1.0 (0.9-1.1)	170	(6.7%)	0.8 (0.7-0.9)
Suicidal thoughts (GP, hosp. or time off)*	204	(3.4%)	136	(2.8%)	0.9 (0.8-1.1)	62	(2.4%)	0.8 (0.6-1.0)
Anxiety (HAD score 8-21)	1186	(19.9%)	1031	(21.7%)	1.0 (1.0-1.1)	541	(21.5%)	1.0 (0.9-1.2)
Depression (HAD score 8-21)	729	(12.2%)	632	(13.3%)	1.1 (1.0-1.1)	345	(13.7%)	1.1 (1.0-1.2)

Prevalence ratio compared with men who had never worked in agriculture and adjusted for birth cohort
*symptom bad enough to see GP, attend hospital or take time off work

The effect of type of farming (arable, livestock, mixed, forestry, other) and employment status in current and ever agricultural workers on mental health was explored. Current agricultural workers were least likely to have sought medical attention or taken time off work for stress or mental illness, but the distribution of anxiety and depression scores was quite similar across types of farming, and in current and ever agricultural workers according to employment status.

7.3 Musculoskeletal disorders

Answers from several questions relating to musculoskeletal disorders provided data for outcome measures. These were ever seeking medical attention or taking time off work for shoulder pain, back pain, arthritis of the hip or knee; symptoms occurring in the past month (back or shoulder pain); and ever having had surgery (hip replacement, knee replacement or knee cartilage surgery).

As described above, we used a modified Cox's proportional hazards model to estimated prevalence ratios for symptoms in men who had worked in agriculture compared to men who had never worked in agriculture. Prevalence ratios were adjusted for birth cohort (all outcomes) and BMI category (hip and knee disorders) as these were identified *a priori* as the most likely potential confounders

Table 7.2 shows the prevalence rates and ratios for outcome measures in ever agricultural workers and those who had worked in agriculture for at least 10 years and started before the age of 30, compared to men who had never worked in agriculture.

Table 7.2 Prevalence and risk of musculoskeletal illness in men who had worked in agriculture.

	Agricultural work				
	Never	**Ever**		**Before age 30 + for at least 10 years**	
	n (%)	**n (%)**	**PR (95%CI)**	**n (%)**	**PR (95%CI)**
HIP					
Arthritis (GP, hosp. or time off)*	283 (4.7%)	297 (6.2%)	1.2 (1.1-1.4)	175 (6.9%)	1.4 (1.2-1.6)
Arthritis (time off work)	72 (1.2%)	101 (2.7%)	1.4 (1.1-1.7)	63 (2.5%)	1.7 (1.3-2.2)
Hip replacement	64 (1.1%)	91 (1.9%)	1.5 (1.2-1.8)	62 (2.4%)	1.9 (1.4-2.4)
KNEE					
Arthritis (GP, hosp. or time off)*	507 (8.5%)	420 (8.8%)	1.1 (1.0-1.2)	217 (8.6%)	1.1 (0.9-1.2)
Arthritis (time off work)	161 (2.7%)	127 (2.7%)	1.0 (0.8-1.2)	68 (2.7%)	1.0 (0.8-1.3)
Knee replacement	37 (0.6%)	27 (0.6%)	1.0 (0.7-1.5)	15 (0.6%)	1.0 (0.6-1.7)
Knee cartilage surgery	421 (7.0%)	298 (6.2%)	0.9 (0.8-1.1)	151 (6.0%)	0.9 (0.8-1.1)
SHOULDER					
Pain (GP, hosp. or time off)*	1297 (21.7%)	1071 (22.4%)	1.0 (1.0-1.1)	529 (20.9%)	1.0 (0.9-1.1)
Pain (time off work)	380 (6.3%)	389(8.1%)	1.1 (1.0-1.3)	193 (7.6%)	1.1 (1.0-1.3)
Pain (past month)	448(7.5%)	431(9.0%)	1.1 (1.0-1.3)	250 (9.9%)	1.3 (1.1-1.5)
BACK					
Pain (GP, hosp. or time off)*	2540 (42.4%)	2219(46.5%)	1.1 (1.0-1.2)	1099 (43.4%)	1.0 (1.0-1.1)
Pain (time off work)	1486 (24.8%)	1295(27.1%)	1.1 (1.0-1.1)	622 (24.5%)	1.0 (0.9-1.1)
Pain (past month)	1222 (20.4%)	1195(25.0%)	1.2 (1.1-1.2)	633 (25.0%)	1.2 (1.1-1.3)

Prevalence ratio compared with never agricultural workers, adjusted for birth cohort (all outcomes) and BMI (hip and knee outcomes)
*symptom bad enough to see GP, attend hospital or take time off work

1.1% of never farmers had had a hip replacement compared to 2.4% of men who had worked in agriculture for at least 10 years (whether or not they started before the age of

30). In those starting before the age of 30 the PR was 1.9. There was an associated increase in the prevalence of having taken time off work, but the age of first time off work often coincided with the age of hip replacement surgery.

The risk of knee problems was similar to that in men in non-agricultural work. Adjusting for BMI made very little difference to the prevalence ratios.

Shoulder pain and back pain (especially back pain) were common symptoms. The results suggested a slightly higher risk of back pain in agricultural workers, regardless of the time that they had worked in agriculture (PR 1.2) although taking time off work for this was not significantly more common than in other occupations. The risk of shoulder pain was increased in men who had worked in agriculture for the longest.

The frequency of heavy lifting (lifting or moving weights of 25kg or more by hand in an average day) in any job was common, but more frequent in ever agricultural workers (87%) than in never agricultural workers (54%).

Using a modified Cox's proportional hazards model approach we found a positive association between heavy lifting at work and seeking medical attention or taking time off work for each of the musculoskeletal complaints we considered. The association appeared to be stronger in those who had never worked in agriculture (table 7.3).

Table 7.3 Risk of musculoskeletal problems in relation to ever holding a job that in involved regular lifting of weights ≥ 25kg.

Outcome: (medical attention or time off work)*	Never agricultural workers	Ever agricultural workers
	PR (95% CI)	PR (95% CI)
Arthritis of the hip	1.9 (1.5-2.5)	1.2 (0.8-1.6)
Arthritis of the knee	1.7 (1.4-2.0)	1.2 (0.9-1.6)
Shoulder pain	1.6 (1.4-1.8)	1.3 (1.1-1.6)
Back pain	1.3 (1.2-1.4)	1.2 (1.1-1.4)

Prevalence ratio for each outcome in those who ever had a lifting job compared to those who did not, adjusted for birth cohort
*symptom bad enough to see GP, attend hospital or take time off work

After adjusting for heavy lifting, the excess risk of back pain in agricultural workers disappeared. The increased risk of hip OA remained, although it was marginally reduced (table 7.4).

Table 7.4 Risk of hip osteoarthritis and back pain in ever agricultural workers compared to never agricultural workers before and after adjusting for heavy lifting

	Ever vs never agricultural workers	Ever vs never agricultural workers after adjustment for ever heavy lifting
	PR (95%CI)	PR (95%CI)
HIP		
Arthritis (GP, hosp. or time off)*	1.2 (1.1-1.4)	1.1 (1.0-1.3)
Arthritis (time off work)	1.4 (1.1-1.7)	1.2 (1.0-1.4)
Hip replacement	1.5 (1.2-1.8)	1.4 (1.1-1.7)
BACK		
Pain (GP, hosp. or time off)*	1.1 (1.0-1.2)	1.0 (1.0-1.1)
Pain (time off work)	1.1 (1.0-1.1)	1.0 (0.9-1.0)
Pain (past month)	1.2 (1.1-1.2)	1.0 (1.0-1.1)

Prevalence ratio for each outcome in ever versus never agricultural workers, adjusted for birth cohort. Hip outcomes also adjusted for BMI
*symptom bad enough to see GP, attend hospital or take time off work

7.4 Hernia

We asked men if they had ever sought medical attention or taken time off work for hernia (i.e. rupture in the groin) and whether they had ever had surgery for hernia. Based on these outcome measures there did not appear to be an increased risk of hernia in agricultural workers (table 7.5). Results suggested only a weak association with ever doing heavy lifting at work in an average day (table 7.6).

Table 7.5 Prevalence and risk of hernia in men who had worked in agriculture.

	Agricultural work				
	Never	Ever		Before age 30 + for at least 10 years	
	n (%)	n (%)	PR (95%CI)	n (%)	PR (95%CI)
GP, hosp. or time off for hernia*	710 (11.9%)	556 (11.6%)	1.0 (0.9-1.1)	304 (12.0%)	1.1 (1.0-1.2)
Hernia repair operation	675 (11.3%)	510(10.7%)	1.0 (0.9-1.1)	275 (10.9%)	1.0 (0.9-1.2)

Prevalence ratio compared with never agricultural workers, adjusted for birth cohort
*symptom bad enough to see GP, attend hospital or take time off work

Table 7.6 Exposure to heavy lifting and risk of hernia*

Lifting or moving loads of 25kg or more at work	Never agricultural workers		Ever agricultural workers	
	Number exposed (%)	PR (95% CI)	Number exposed (%)	PR (95% CI)
Never	2746 (46%)	1.0	635 (13%)	1.0
Ever	3243 (54%)	1.1 (1.0-1.3)	4141 (87%)	1.3 (1.0-1.7)

Prevalence ratio compared with never exposed and adjusted for birth cohort
*seeking medical attention or taking time off work for hernia. (PRs calculated for hernia operation as the outcome measure were very similar).

7.5 Raynaud's phenomenon

Men were asked if they had ever had episodes when any or all of their fingers suddenly became cold and numb at the same time became white or pale (i.e Raynaud's phenomenon). In those who had ever worked in agriculture, for however long, there was an increased risk of this symptom. Almost one in four men working in agriculture had experienced such symptoms at some time (table 7.7). The risk was highest in men who had worked in forestry.

Table 7.7 Prevalence and risk of Raynaud's phenomenon in men who had worked in agriculture.

	Agricultural work						
	Never	Ever		Before age 30 + for at least 10 years		Ever forestry	
	n (%)	n (%)	PR (95%CI)	n (%)	PR (95%CI)	n (%)	PR (95%CI)
Fingers ever cold, numb and white	1082 (18.1)	1175 (24.6)	1.3 (1.2-1.3)	630 (24.9)	1.3 (1.2-1.5)	283 (30.9)	1.7(1.6-2.0)

Prevalence ratio compared with never agricultural workers, adjusted for birth cohort
Prevalence ratios calculated using modified Cox's proportional Hazards Model

There was a clear association between Raynaud's phenomenon and using power tools or vibrating machinery in an average working day in a job. If anything the association was stronger in those who had never worked in agriculture. However, a higher proportion of men who had had agricultural jobs reported having used tools that made their hands vibrate in a job, and the proportion was higher still in men who had worked in forestry (table 7.8). 25% of ever agricultural workers reported symptoms and 42% of ever agricultural workers who had used vibrating tools at work reported cold induced finger blanching. However the increase in risk remained after adjusting for ever use of a vibratory tool (PR in ever agricultural workers compared to never was reduced from 1.3 to 1.2 (95%CI 1.2-1.3)).

Table 7.8 The risk Raynaud's phenomenon in relation to use of vibratory tools at work among ever and never agricultural workers and ever forestry workers

Use of power tools or vibrating machinery at work	Never agricultural workers		Ever agricultural workers		Ever forestry workers	
	Number exposed (%)	PR (95% CI)	Number exposed (%)	PR (95% CI)	Number exposed (%)	PR (95% CI)
Never used	3545 (59%)	1.0	1956 (41%)	1.0	206 (22%)	1.0
Ever used	2444 (41%)	1.6 (1.4 -1.8)	2820 (59%)	1.4 (1.2-1.6)	710(78%)	1.6 (1.2-2.3)
Currently using	1047 (17%)	1.4 (1.2-1.6)	1851 (39%)	1.2 (1.1-1.4)	446 (49%)	1.2 (0.9-1.5)

Prevalence ratio compared with never exposed and adjusted for birth cohort

7.6 Respiratory disorders and allergy

Several outcome measures were used for respiratory disorders. In order to assess asthma and allergy subjects were asked if they had ever sought medical attention or had time off work for asthma, and whether they had had wheezing or whistling in their chest in the past year. Questions 27 to 30 in the questionnaire (appendix 5) were items from an instrument to measure bronchial hyperresponsiveness and asthma[298]. At least three positive answers out of a possible nine were taken as an indicator of bronchial hyperresponsiveness. Our measure for hay fever was whether the subject had ever been told by a doctor that he had hay fever. For other respiratory problems, (dyspnoea, cough on most days and cough with phlegm most mornings for three months or more per year, for over a year,) we used self-report of symptoms.

As before, prevalence ratios were calculated using a modified Cox's proportional hazards model. The results were adjusted for birth cohort and smoking status (never, ever or current smoker) as these were identified *a priori* as the most likely potential confounders.

There appeared to be no increase in risk of asthma or bronchial hyperresponsiveness among agricultural workers, though there was a slightly increased risk of symptoms associated with chronic bronchitis (cough with phlegm for at least 1-3 years), which increased further after adjustment for smoking status.

The risk of hay fever was significantly lower among agricultural workers compared to men who had never done that type of work. The risk was lowest in the group who had spent the longest working in agriculture and started below the age of 30 years (table 7.9).

Table 7.9 Prevalence and risk of respiratory symptoms and allergy in men who had worked in agriculture.

	Agricultural work				
	Never	Ever		Before age 30 + for at least 10 years	
	n (%)	n (%)	PR (95%CI)	n (%)	PR (95%CI)
Asthma (GP, hosp. or time off)*	550 (9.2%)	442 (9.3%)	1.0 (0.9-1.1)	227 (9.0%)	1.0 (0.9-1.1)
Wheezing/whistling in past year	1367 (22.8%)	1163 (24.4%)	1.1 (1.0-1.2)	611 (24.1%)	1.1 (1.0-1.2)
Dyspnoea in past year	771 (12.9%)	553 (11.6%)	1.0 (0.9-1.1)	280 (11.0%)	1.0 (0.9-1.1)
Cough most days	873 (14.6%)	826 (17.3%)	1.2 (1.1-1.2)	454 (17.9%)	1.3 (1.1-1.4)
Cough with phlegm for at least a year	514 (8.6%)	555 (11.6%)	1.2 (1.1-1.4)	292 (11.5%)	1.4 (1.2-1.5)
Bronchial hyperresponsivness°	742 (12.4%)	648 (13.6%)	1.1 (1.0-1.2)	324 (12.8%)	1.1 (1.0-1.2)
Hay fever	1041 (17.4%)	518 (10.8%)	0.7 (0.6-0.8)	202 (8.0%)	0.5 (0.4-0.6)

°at least three out of a possible nine (see questionnaire qu 27-30)
Prevalence ratio compared with never agricultural workers, adjusted for birth cohort and smoking status
*symptom bad enough to see GP, attend hospital or take time off work

One third of subjects (3529) had lived on a farm before the age of 16 years. Their risk of respiratory disease was compared with subjects who had not lived on a farm in childhood, using a modified Cox's proportional hazards approach. The risk of hay fever was reduced in subjects who had lived on a farm before the age of 16 years (PR 0.6 (95% CI 0.5-0.6)).

Among men who had lived on a farm as a child, those who had ever worked in agriculture over the age of 16 years had a lower risk of hay fever than those who had not (table 7.10).

Table 7.10 Respiratory and allergic symptoms in men who had lived on a farm before the age of 16 years

	Agricultural work		
	Never n (%)	Ever n (%)	PR (95% CI)
Asthma (GP, hosp. or time off)*	42 (7.0%)	241 (8.4%)	1.2 (0.8-1.6)
Wheezing/whistling in past year	131 (21.9%)	663 (23.2%)	1.1 (0.9-1.4)
Dyspnoea in past year	74 (12.4%)	310 (10.9%)	1.0 (0.7-1.2)
Cough most days	106 (17.7%)	493 (17.3%)	1.1 (0.9-1.3)
Cough with phlegm for at least a year	74 (12.4%)	325 (11.4%)	1.0 (0.8-1.3)
Bronchial hyperresponsivness°	77 (12.9 %)	352 (12.3%)	1.0 (0.8-1.3)
Hay fever	88 (14.7%)	225 (7.9%)	0.6 (0.6-0.7)

°at least three out of a possible nine (see questionnaire qu 27-30)
Prevalence ratio compared ever with never agricultural workers, adjusted for birth cohort and smoking status
*symptom bad enough to see GP, attend hospital or take time off work

Most of the subjects who lived on a farm at a young age were on farms with livestock, and most had lived on a farm before the age of two years. The type of livestock on the farm did not appear to influence the risk of symptoms significantly, and the numbers without exposure to livestock were too small for useful conclusions.

Living on a farm as a child did not appear to affect the risk of other respiratory symptoms. In particular, there was no evidence of a protective effect against asthma or bronchial hypersensitivity.

7.7 Hearing difficulty

There was no increased risk of reported hearing difficulty among agricultural workers. Table 7.11 shows that when adjusted for birth cohort, the risk of self-report of hearing difficulty or wearing a hearing aid was the same in agricultural and non-agricultural workers.

Table 7.11 Prevalence and risk of hearing difficulty in men who had worked in agriculture.

Hearing difficulty measure	Agricultural work: Never	Ever		Before age 30 + for at least 10 years	
	n (%)	n (%)	PR (95%CI)	n (%)	PR (95%CI)
Difficulty leading to GP, hosp. or time off*	692 (11.6%)	552 (11.6%)	1.0 (0.9-1.1)	250 (9.9%)	0.9 (0.8-1.1)
Wear hearing aid	197 (3.3%)	136 (2.8%)	1.0 (0.8-1.2)	69 (2.7%)	1.0 (0.8-1.2)
At least moderate difficulty in a quiet room (either ear)	539 (9.0%)	448 (9.4%)	1.1 (1.0-1.2)	220 (8.7%)	1.0 (0.9-1.2)

Prevalence ratio compared with never agricultural workers, adjusted for birth cohort
*symptom bad enough to see GP, attend hospital or take time off work

Subjects were asked for how long altogether they had worked in noisy places where conversation would be impossible without shouting (question 9, appendix 5). We found a positive association of at least moderate difficulty hearing with noise exposure at work and with gunfire. The association of hearing difficulty with noise exposure was similar in those who had worked in agriculture and those who had not, but reported exposure to noise at work and to firing a gun was higher in men who had worked in agriculture (table 7.12).

Adjustment for noise exposure at work and gun fire made little difference to the prevalence ratios shown in table 7.11 for ever farmers. Both for wearing a hearing aid and for at least moderate hearing difficulty in either ear, the adjusted prevalence ratios were reduced by 0.1.

Table 7.12 The risk of at least moderate hearing difficulty in a quiet room in either ear according to years of exposure to noise at work in ever and never agricultural workers

Time spent working in noisy environments	Never agricultural workers		Ever agricultural workers	
	Number exposed (%)	PR (95% CI)	Number exposed (%)	PR (95% CI)
Never	3446 (60%)	1.0	1751 (39%)	1.0
Less than 1 year	672 (12%)	1.3 (1.0-1.8)	958 (22%)	1.6 (1.1-2.2)
1-5 years	641 (11%)	1.8 (1.4-2.4)	567 (13%)	2.4 (1.7-3.4)
6-10 years	282 (5%)	2.5 (1.8-3.6)	238 (5%)	4.8 (3.4-6.8)
More than 10 years	743 (13%)	3.3 (2.6-4.0)	931 (21%)	3.5 (2.7-4.5)
Firing a gun				
More than 100 times	1593 (28%)	1.4 (1.2-1.7)	2401 (52%)	1.5 (1.2-1.8)

Prevalence ratio compared with never exposed and adjusted for birth cohort

7.8 Dermatitis and skin cancer

Using the statistical method described above we estimated the risks of seeking medical attention for dermatitis and for skin cancer. The results in table 7.13 suggest that, if anything, the risks were marginally lower in agricultural workers compared to those who had never worked in agriculture.

Table 7.13 Prevalence and risk of dermatitis and skin cancer in men who had worked in agriculture

	Agricultural work				
	Never	Ever		Before age 30 + for at least 10 years	
	n (%)	n (%)	PR (95%CI)	n (%)	PR (95%CI)
Dermatitis (GP, hosp, time off)*	475 (7.9%)	347 (7.3%)	1.0 (0.9-1.1)	150 (5.9%)	0.8 (0.7-0.9)
Skin cancer (GP, hosp, time off)*	154(2.6%)	83 (1.7%)	0.8 (0.7-1.0)	40 (1.6%)	0.7 (0.5-1.0)

Prevalence ratio compared with never agricultural workers, adjusted for birth cohort
*symptom bad enough to see GP, attend hospital or take time off work

7.9 Summary of main findings

We identified differences between workers in agriculture and other occupations for several health outcomes and associated risk factors including hip OA and Raynaud's phenomenon. For other outcomes such as hernia and knee OA, agricultural work did not appear to be a risk factor.

7.9.1 Mental health

Agricultural workers were less likely to seek help for stress or mental illness than the general population although the prevalence of depression and anxiety was similar. No particular types of farming were identified as being at high risk, though this may have been partly due to limited heterogeneity in the sample with respect to combinations of type of farming.

7.9.2 Musculoskeletal symptoms and hernia

There was a clear association of agricultural work with hip osteoarthritis and hip replacement. Agricultural workers were also at a slightly increased risk of current back pain and shoulder pain, but there was no associated increase in time off work for these complaints. Heavy lifting accounted for the increased risk of back pain but only partially explained the differences observed for hip osteoarthritis. The risk of knee problems was similar for agricultural work and non-agricultural work, as was the risk of hernia.

7.9.3 Raynaud's phenomenon

Raynaud's phenomenon was more frequent in ever agricultural workers than never agricultural workers. Ever using tools or machinery that made hands vibrate partially explained the differences observed.

7.9.4 Respiratory disorders and allergy

Men who had worked in agriculture had a slightly increased risk of cough and phlegm but the risk of asthma or wheezing was similar to that in other occupations. The risk of hay fever was significantly lower among agricultural workers. One factor said to reduce hay fever and other allergic symptoms is exposure to antigens at a young age, such as might occur when living on a farm as a child. In our study subjects living on a farm as a child did have a reduced risk of hay fever compared to those who did not. This protection appeared to be confined mainly to those who worked in agriculture during adult life.

7.9.5 Hearing difficulty and skin disorders

Hearing difficulty was not more prevalent among agricultural workers at a given level of exposure, although the expected relation was seen with years of exposure to noise and noise exposure was somewhat more common. The risk of seeking medical attention for dermatitis or skin cancer was slightly lower among agricultural workers than in other men.

7.10 Strengths and Limitations of the study

The outcomes discussed in this chapter were not the main focus of our study so analyses were limited. However, some useful information has emerged both in supporting established findings such as the risk of osteoarthritis of the hip in farmers, and providing information in areas where little work has been done previously such as the prevalence of hernia in UK farmers.

The added value of this study, particularly for musculoskeletal outcomes was that we considered several outcomes in the same population so that we were able to assess their relative importance in relation to agricultural work. Also, because this was a community based study with a large pool of men who had worked in agriculture we were able to make comparisons between risks in agricultural work and other occupations.

As discussed in earlier chapters the possible effect of response bias needs consideration. While it was possible that men with health problems preferentially responded, each outcome in this chapter was a minor component of the questionnaire so it is unlikely that this bias was large. There may have been some effect on the reported frequency of symptoms, but estimates of risk would not be affected unless there was significant differential non-response between agricultural workers and non-agricultural workers for the outcomes in question, and it seems unlikely that this was the case.

The outcomes used were a mixture of ever and current symptoms. It is possible that recall of past symptoms was less complete than for current symptoms, but less likely that recall was different between our comparison groups. Using either current or ever measures as an indicator of disease did not seem to make much difference to the associations with work and disease in the groups we compared. For example, a range of outcome measures was used to assess respiratory disease, and the risks we estimated for types of respiratory disease followed a consistent pattern. We did not have sufficient information to link exposure with onset of symptoms, so the associations we observed may not indicate a causal effect. In some circumstances reverse causation could be a factor. For example, many men with a history of hay fever may have chosen not to do agricultural work

Some inaccuracy in recall of exposures was likely, for example the duration of time spent working in noisy environments. Questions on use of ear protectors or how frequent and for how much of the day noise exposure occurred were not included in the questionnaire. Ignoring these factors would be expected to reduce the association with outcome, but despite this, we still found a positive association with years of work in a noisy environment.

The classification used to identify agricultural workers was a simple one that was practical to use. Ever agricultural workers included some men who had worked in agriculture for only a short period of time, and those who owned a smallholding but had done other jobs for most of their working lives. The inclusion of part-time or short-term farm workers in the group may have reduced exposure contrasts related to work in agriculture leading to an underestimate of relative risks.

Potential confounding variables we had collected information on, including age and factors relevant to specific outcomes, were taken into account. Because the study was not designed to look in detail at health outcomes in this chapter, inclusion of all potential confounders was not feasible, but those not included were least likely to be important. For example, musculoskeletal problems could be associated with sporting activities and previous injuries, but those have not consistently been shown to be important risk factors for hip osteoarthritis [342]. Other risk factors for hip OA, such as Perthes disease, slipped femoral epiphysis and congenital dislocation of the hip are relatively uncommon so unlikely to have influenced on our results importantly. Some of the risk factors examined, for example ever heavy lifting, and ever using vibratory tools or machinery, were crude measures of exposure in relation to types of work. However they were useful as indicators of exposure and our results were consistent with other findings.

7.11 Discussion of results

7.11.1 Mental Health

The results suggest that if anything, agricultural workers tended to be a little more depressed than other men but that they were less likely to seek medical advice about it. No studies of agricultural workers have assessed mental health in a directly comparable way. A Norwegian study used the HAD score to compare male and female farmers aged 40-49 years to non-farmers, and based on mean scores found them to have higher levels of anxiety and depression[89]. However British farmers were found to have lower psychiatric morbidity than the general population, when assessed by a different measure (CIS-R)[90], though in that study a specific measure (thinking life was not worth living) was more prevalent in farmers.

There is a difficulty in understanding how much of a handicap measured levels of depression are in different groups. Our data suggests that agricultural workers reported seeking medical help for mental health problems less than non-agricultural workers who have a similar distribution of anxiety and depression scores. Other studies suggest that while farmers are just as likely to seek medical attention when they have mental health problems, they tend to present with just physical symptoms [13, 45]. Thus it may be that acceptance of a mental health problem as a treatable condition is lower in agricultural workers.

Assessment of mental health related outcomes by type of farming was not very helpful in elucidating whether types of work were high risk because most men were involved either in mixed farming (livestock and arable) or just livestock farming. The prevalence of outcomes for these two groups was similar. Few agricultural workers did only arable, forestry or "other" types of farming. Other studies have suggested that farmers who own livestock may be at a higher risk of stress related symptoms compared to solely arable farmers [65, 89] although there is no clear evidence of suicide risk being associated with a particular type of farming.[45]

7.11.2 Musculoskeletal Disorders

The increased risk of hip OA that we found in agricultural workers is consistent with other studies.[37, 133] In our study, the fact that the association with hip OA was much stronger than for other musculoskeletal complaints adds validity to this association.

The specific risk factor we examined, "ever regularly lifting weights of 25kg or more in a job in an average day", was associated with OA hip but only partially explained the difference between those who had worked in agriculture and those who had not, despite the fact that a higher proportion of agricultural workers reported heavy lifting at work. This could be because our measure was not a precise one. However the results are consistent with other findings that suggest prolonged heavy lifting is an important factor that contributes to OA hip.[131, 137] The risk of hip OA has also been found to be higher in jobs involving prolonged standing and walking over rough ground, though these risk factors and heavy lifting tended to be associated.[131] The difference in risk of hip OA between farmers and other occupations has not been fully explained by differences in measured risk factors,[167] but this could be because of the difficulty in measuring risk factors (particularly lifting) with sufficient precision.

For the other outcomes that we considered, there was less information from earlier research on the risk in agricultural compared to non-agricultural occupations. Back pain is a common occupational problem. Finnish data has suggested that back pain is a common cause of work disability in farmers but did not indicate how this compared with the rest of the working population.[15] Our data showed that the risk of current back pain in agricultural workers was higher than in those who had never worked in agriculture, although seeking medical attention and taking time off work for back pain were not significantly higher. There was a similar association between lifting heavy weights at work and seeking medical attention for back pain in never and ever agricultural workers. Agricultural workers were more likely to have done heavy lifting on a regular basis, and heavy lifting seemed to account for their higher prevalence of back pain.

The lower risk of seeking medical attention or taking time off work, particularly in longer-term agricultural workers, could suggest that the threshold for coping with pain was higher in agricultural work or that there were less perceived benefits associated with not working. In Britain, in order to claim sickness and incapacity benefit, sufficient financial contributions must have been made. Those who are self-employed or doing contractual work, which includes many agricultural workers, are less likely to benefit financially from taking time off. Psychosocial factors are also important in relation to back pain and have been discussed in chapter 2 and chapter 8.

Agricultural workers appeared to be at a slightly increased risk of shoulder pain, and this was associated with heavy lifting. Disabling shoulder pain has been shown to be associated with both occupational physical demands and the psychological working environment.[168] Shoulder pain has not been identified as a specific problem in farmers although there is some data suggesting that neck and shoulder disorders are a cause of work disability in Finnish farmers.[15]

Finnish and Swedish studies have also identified knee osteoarthritis as a problem in farmers [15, 133], but not in excess compared to some other occupations.[146] No excess risk was apparent in our study. A number of other occupations have been shown to be specifically at higher risk of knee problems, particularly those involving kneeling.[167] Although heavy manual labour does appear to be a risk factor, farming has not been specifically recognised as a high risk occupation.

7.11.3 Hernia

Mortality data from 1979-1980 and 1982-1990 has suggested that male farmers were around twice as likely to die from inguinal hernia when compared to the male population of England and Wales.[83] No studies comparing the risk of having hernia in farmers to other occupations have been identified, though precipitating risk factors that could be associated with farm work such as heavy lifting and type of lifting[180-182] have been reported. Our study suggests that seeking medical attention for hernia and hernia repair surgery were not more frequent among agricultural workers. It is possible that the excess deaths in farmers over 11 years[83] were a chance finding, despite statistical significance, given the fairly small number of deaths. Hernia has not been mentioned in mortality studies from other countries that have calculated PMRs for farm workers.[177, 178] Alternatively if the increased risk of death was real, an explanation could be that hernia is in fact more prevalent in agricultural workers, but they do not seek medical attention routinely, so present later. If this were the case they would be more likely to present late and be at a higher risk of complications. A lower tendency to seek medical attention would be consistent with other findings of this study.

Hernia deaths are not a big public health problem. A relatively low number of farmers die from hernia (82 male farmers and 58 female farmers or farmers wives (aged 20-74 years) were recorded over 11 years for inguinal hernia (ICD9 550) and other hernias (ICD9 551-553)).[83] In 2000 there were 621 deaths in total recorded (ICD9 550-553) in England and Wales. It is not known what proportion of hernia deaths might be preventable through earlier intervention.

7.11.4 Raynaud's phenomenon

We found a higher risk of Raynaud's phenomenon in agricultural workers than in other occupations, especially those who did forestry work, and this was associated with use of tools that made the hands vibrate. This supports findings from a large population survey which found that agricultural workers were at increased risk of cold induced finger blanching.[271] However that survey included relatively few farmers.

While ever using tools or machinery that made hands vibrate was more common in agricultural workers, this only partially explained the differences we observed. A reason for this could be that the question on exposure was an imperfect measure, for example the level of exposure was not taken into account. It is also possible that other factors such as outdoor work in cold wet weather may have contributed to symptoms. Recent exposure appeared to be a weaker risk factor than ever exposure. This could reflect selection out of exposure because of symptoms. However, as we did not ask about when symptoms first occurred conclusions cannot be drawn from this finding.

In the earlier survey detailed information on exposure to vibrating tools in the previous week was collected as well as some information on past exposure.[270, 343] Our measure was less precise but the results of the two studies are consistent.

7.11.5 Respiratory disorders and allergy

Studies discussed in section 2.8, suggest that respiratory problems are an important cause of morbidity in agriculture but it is less clear how the prevalence of common respiratory disorders compares with that in the general population, nor the importance of agricultural work in precipitating or aggravating common respiratory diseases.

Our results suggested a higher prevalence of symptoms associated with chronic bronchitis (cough most days and cough with phlegm most mornings for three months or more per year, for over a year), in agricultural workers, particularly after controlling for smoking. This is consistent with findings from Canada,[237] France[239] and Norway.[3] In the European studies, livestock production appeared to be an important risk factor.

Asthma and bronchial hyper-responsiveness was not more common in agricultural workers. This is consistent with a large European study [209, 210] and UK data[215] but other studies have produced conflicting results with respect to relative prevalence.[211, 212] Norwegian farmers were found to be at a lower risk of both atopic and non-atopic asthma than the general population,[344] although within adult farmers exposure to antigens (endotoxins and fungal spores) appeared to have a protective effect against atopic asthma, yet were positively associated with non-atopic asthma.[345] The agricultural environment includes both harmful and protective factors, so maybe on balance there is a null effect. The healthy worker effect may also have an impact on asthma prevalence in adult agricultural workers. Agricultural risk factors include working in glasshouses[227] or with grain,[226] and living on a farm in childhood has been shown to be protective against childhood asthma,[218, 220] though the evidence for protection against hay fever and eczema is stronger than for asthma. Our outcome measure for asthma (seeing a GP or hospital attendance) included adults but was not restricted to adults. Bronchial hypersensitivity questions implied current (adult) symptoms. We did not find that the prevalence of (mainly adult) asthma was affected by living on a farm in early life.

We did find, however, that hay fever was less frequent among ever agricultural workers. A single outcome variable asking about doctor-diagnosed hay fever was used. A difference in consulting tendency may have affected this, although there is no evidence that agricultural workers and farm children systematically consult less for this reason. Although some types of farming have been associated with hay fever[85, 231, 235, 236] our findings were consistent with low hay fever prevalence compared to the general population in other European countries.[207, 226, 236]

Factors associated with lower risk of ever seeing a doctor for hay fever seemed to be living on a farm as a child and working in agriculture as an adult. Those who lived on a farm as a child and ever worked in agriculture appeared to have a lower risk of hay fever than those who only lived on a farm under the age of 16 years. This could be due to amount of exposure. In other studies living on a farm early in life particularly if exposed to animals seems to have been protective for childhood hay fever and eczema fairly consistently [10, 217, 220, 221]. These studies have not investigated whether protection extends to adult life. We may have been measuring childhood or adult hay fever or both in our study, but it seems reasonable to assume that adult hay fever did contribute.

Exposure to animals and exposure in early childhood appear to be protective factors in studies of farm children and atopy.[9] Most of our subjects who had lived on a farm before aged 16, had been on a farm before the age of two and had been exposed to animals. However our results suggest that there is something about working in agriculture later that is also important. A reason why the protective effect in our study was greater in agricultural workers could be that these individuals were more likely to be part of a farming family than those who never did any agricultural work over the age of 16 years, so they may have had more relevant exposure. This could apply to childhood or adult hay fever. Alternatively, in adults, repeated exposure to allergens may be required to maintain the protective effect in adulthood.

On the other hand the results could be explained by a self-selection process in adults, i.e. that those with a predisposition for atopic symptoms avoided agricultural work. This is unlikely to apply to childhood symptoms.

7.11.6 Hearing difficulty

The risk of hearing difficulty in agricultural workers was similar to never agricultural workers despite their higher prevalence of exposure to noise at work and to gun fire.

Exposure to noise at work only explained a small amount of reported hearing difficulty in ever agricultural workers.

Our measures of noise exposure could not accurately quantify the amount of noise exposure, for example the length of time for which individuals were exposed to noise in an average working day and the exact level of noise exposure. It is possible that in agricultural occupations most of the noise exposure was at work whereas non-work noise exposure such as traffic noise and loud music could be could be more significant in never agricultural workers, particularly if they had not lived in a rural area all their lives.

However the results provide no evidence that hearing difficulty in agricultural workers is a greater problem than in other industries.

7.11.7 Skin disorders

Occupational dermatitis has been identified as a problem in farmers in other countries and there is a concern that it is under-reported in Britain. Our only outcome measure was ever seeking medical attention or taking time off work for dermatitis. There was no difference in risk in ever compared to never agricultural workers, and longer term agricultural workers were at a lower risk in our study. For those who did consult, we do not know how often they consulted, how much of a problem their skin disorder was, or whether it was aggravated by work. Limited evidence from a Lancashire practice suggested that farmers did consult their GP for skin disorders more frequently than age matched controls over a five year period.[12]

The risk of skin cancer was lower in agricultural workers than in never agricultural workers. We did not collect information to enable us to distinguish between cancer types, so could not address whether agricultural workers were at an increased risk of squamous cell carcinoma.

The overall findings are consistent with data from the Finnish cancer registry. Basal cell carcinoma (BCC) is the commonest form of skin cancer, so should have the biggest influence on incident rates. Data from the Finnish cancer registry suggests a low incidence of BCC in farmers and forestry workers.[346] Swedish data suggest that risk of melanoma in farmers is not increased despite an excess on the face neck and scalp,[347] and this is consistent with mortality data from England and Wales for 1979-80 and 1982-90, which shows that farmers do not have a particularly high mortality from melanoma of the skin (ICD9 172).[16]

However, a review of cancer in farmers suggests that non-melanomatous skin cancer is one of several types of cancer frequently showing excess risk in this occupational group.[348] Cancer Registry data for England (1981-87) suggests that male farmers are among the higher risk job groups for cancers of the skin other than melanoma (ICD9 173).[16] All skin cancers were categorised into two types in ICD9, melanoma and other. The relative risk by occupation was expressed as the proportional registration ratio (PRR). This was calculated in the same way as proportional mortality ratio (PMR), all registrations with an adequately described occupation forming the standard for comparison. The PRR was118 (95% CI 110-127) in farmers, but this was lower than in several other job groups including male teachers (PRR 163), aircraft flight deck officers (PRR 207), male and female doctors (PRR 148 and 144), bricklayers (PRR 126) and male physical scientists and mathematicians (PRR 153).[16] Some of the job types at increased risk involve outdoor work and this supports the suggestion that outdoor work and consequent exposure to ultraviolet radiation is associated with cancers of the skin other than melanoma. However, there may be other factors such as leisure exposure contributing, as several categories of heath professionals, physical scientists and mathematicians appeared to be at increased risk.

7.12 Conclusions

Mental health problems

Mental health problems, according to the measures we used, did not appear to be a particular problem in agricultural workers compared to other men, though the data supports the notion that, as a group, farmers may be more reluctant to seek medical attention for mental health problems. Depression may be one factor that contributes to a high suicide rate in farmers, but the excess is probably attributable to a combination of factors including ready access to methods for committing suicide.

Hip OA

Based on previous research findings, hip OA is already a prescribed occupational disease in farmers (i.e. compensation is available through the social security system). Repeated heavy lifting is one factor that has been shown to contribute to hip disease. Over a number of years the amount of heavy lifting in agricultural work has reduced because of the availability of machinery and regulations concerning lifting. The impact of this change on the risk of hip OA should be reviewed in the future, particularly in younger men.

Back pain

Heavy lifting appeared to account for an excess risk of low back pain in agricultural workers. As with hip OA, the effectiveness of interventions to reduce heavy lifting should be assessed.

Shoulder pain

Heavy lifting was associated with an increased risk of reported shoulder pain in agricultural workers. However agricultural workers were not more likely to consult for shoulder pain and it had not previously been identified as an occupational problem in this group. If heavy lifting is the main factor contributing to the excess risk then appropriate interventions are already in place and should be monitored for effectiveness.

Knee pain

Knee pain does not appear to be an occupational problem in agriculture. This is consistent with previous studies, and this is not an area that requires further research or intervention measures.

Hernia

Data from England and Wales in the 1980s suggested that farmers were at an increased risk of death from hernia of the abdominal cavity. Our data suggested no excess prevalence of hernia in agricultural workers based on self-report of medical consultation. Given the small numbers of deaths attributed to this cause each year, it is not a priority for further investigation at the present time.

Raynaud's phenomenon

The excess risk of Raynaud's phenomenon in agricultural workers, particularly foresters, can be explained, at least in part, by their use of vibratory tools and machinery at work. It has been shown that in those with extensive finger blanching, withdrawing from or limiting further exposure can improve symptoms.[270] There are also engineering measures to decrease vibration at source through modification of chain saws. Hand transmitted vibration is a well recognised problem among foresters. However, men who are primarily farmers may be less well informed and should be targeted for education and screening so that those who have a significant problem can be identified and offered advice.

Respiratory disorders and allergy

Our results suggest that this is not an area that needs further research or new interventions. On balance agricultural work was protective against hay fever. Asthma did not appear to be enough of an occupational problem in agricultural workers to warrant any specific intervention. Symptoms of chronic bronchitis (dysnopea and cough with phlegm) did appear to be more common in agricultural workers and could be associated with the farming environment. General safety advice in the form of information on sources of irritants and respiratory allergens or poisons is published, together with advice on measures to minimise exposure such as use of suitable respiratory protective equipment and local exhaust ventilation systems.[326] Respiratory protection tends to be promoted in relation to less common disorders that are clearly associated with agricultural work, rather than the prevention of chronic bronchitis. Adequate measures to minimise exposure to dust and fumes may decrease the prevalence of chronic cough and phlegm in agricultural workers, and this potential benefit should be included in health and safety literature produced for them.

Hearing difficulty

There was no excess of hearing difficulty in agricultural workers, so it is not a priority area for new research.

Skin problems

Our data suggested that skin problems were less of a problem in agricultural workers than in other occupations. Cancer incidence data suggests that agricultural workers do have a small excess risk of skin cancer other than melanoma, but less than other job groups that may or may not involve working outdoors for much of the time. It is not clear whether regular or intermittent exposure to sunlight, other sources of ultraviolet radiation or possibly other factors are important in the aetiology of types of non-melanomatous skin cancer. One way in which the association between potential causal factors and skin cancer other than melanoma could be addressed would be by a large case control study.

CHAPTER 8: HEALTH RELATED JOB LOSS

8.1 Introduction

Health status may affect a person's ability to work in several ways. Poor health may affect how easily or how well a person can carry out a particular job, whether they can do specific tasks within a job, whether they need to take time off work and whether they can do the job at all.

Agricultural workers might conceivably have relatively high health-related job difficulties and job loss, given the arduous nature of their work and the hazards of the industry. They are not covered by occupational health services and job loss is not reportable under RIDDOR and poorly covered by other reporting schemes, so the scale of the problem is unmeasured at present. Vocational rehabilitation may be needed, but at present there is no service provision and no data to establish the need.

In this study we considered the importance of health related job loss and how factors associated with leaving agricultural jobs (farm, forestry and horticulture) compared with other occupations.

The questions addressed on this topic were about

- the frequency of leaving agricultural or other jobs for various categories of health reasons
- the risk of leaving an agricultural or other job by age, time period and area
- occupational risk factors associated with job loss
- subsequent employment following health-related job loss

8.2 Leaving work for a health problem – methods

Four different methods of analysis were used to address the above questions. Initial analyses used simple descriptive statistics and were based on all men reporting health related job loss. Subsequent analyses included a large subgroup of these men. In order to estimate risk of job loss we used a person-years approach and Poisson regression for all subjects who provided sufficient information on their job history. From this cohort, cases (who had left a job for health reasons) and matched controls (who had not left a job for health reasons) were selected to investigate the association between health-related job loss and occupational risk factors by means of a nested case-control analysis. Finally we looked at the occupational histories of cases used in the case-control and person-years analyses to assess subsequent employment. The process of selection of subjects for each stage of the analysis is illustrated in figure 8.1, and described below.

8.2.1 Selection of subjects

Subjects were asked to complete question 7 (appendix 5) if they had left a job because of a health problem, giving their occupation and age at the time and the reason why they left, for each job they had given up. Jobs reported as having been left for a health reason were excluded from all analyses if the subject was not, in fact, in a paid occupation at the time (e.g. looking for work, retired, student, carer). If the text describing the health reasons suggested that the subject did not actually leave the job, (e.g. 6 months off for cancer treatment, reduced work, or changed tasks done within same job such as stopped driving a tractor or dipping sheep but carried on farming), the event was not counted as a job loss. Also, jobs that were apparently left for social rather than personal health reasons (e.g. to look after wife) were not included as health related job loss. If subjects ticked 'no' to the stem question but gave details, or ticked 'yes' to the stem but gave no further details they were assumed not to have left a job.

Initial descriptive analyses were on all those who had left at least one job for a health reason, after the above exclusion criteria had been applied. Other analyses were based on the cohort of subjects who had provided information about their life history of long-term jobs (i.e. those held for at least a year) in answer to question 6. The cohort was used to calculate person years at risk in all long-term jobs and long-term agricultural jobs up to June 2003. A subject was eligible for inclusion if he had held at least one valid job between the ages of 16 and 64 years, with start and finish ages (recorded or imputed from answers on other jobs). Subjects ceased to be at risk if they left a job for a health related reason or stopped working for other reasons. Invalid entries included jobs held for less than one year, periods of unemployment, being off sick, and being a student or in retirement.

Within the selected cohort, cases were subjects who had left a job, which they had held for a year or longer, for a health reason. The first valid job they left was used in the analyses. In order to become a case the information provided in question 7, about jobs left, had to be satisfactorily matched to a job described in question 6. All records of jobs left were checked against occupational histories and subjects were included as cases if their records provided adequate match on job title <u>and</u>

a) exact match for age left job (1229 subjects) <u>or</u>

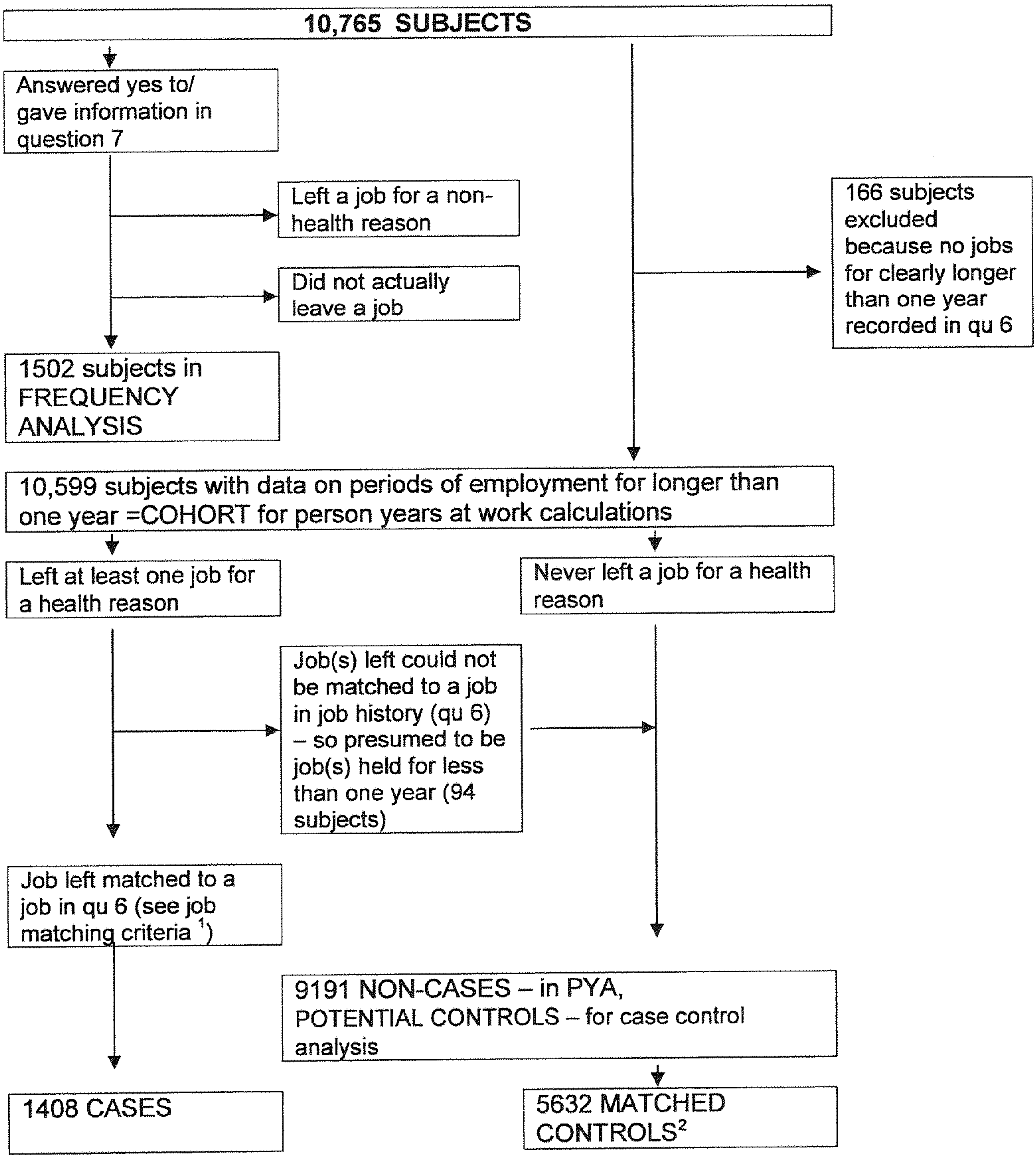
b) match for age left job within 6 years (125 subjects) <u>or</u>

c) age finished job in qu 6 more than 6 years after age left job in qu 7 (54 subjects)

For those falling into b) it was assumed that the differences in ages recorded were because of the difficulty some subjects had in recalling exact ages (quite a few subjects noted this). The age they reported leaving the job in question 7 was adjusted to that given in question 6 for consistency. For those falling into c) it seemed probable that the subject had left the job stated and started another job in the same occupation, but not made the distinction between jobs in their occupational history. Therefore the job record in question 6 was amended to create two jobs – the first finishing at the age given in question 7 and the next starting at an unknown age. Subjects who reported leaving jobs for valid health reasons, but who did not record any of the jobs left in their history of long-term occupations, were presumed to have left jobs that they held for less than a year, so were ineligible for inclusion as cases (although they could contribute person-years at risk).

Further questions, on risk factors for health-related job loss were addressed by means of a case-control study, nested within the same cohort. Cases were the same as those already identified for the person-years analysis. The matched controls were selected from members of the cohort who were not cases. Four controls per case were identified. Each was matched for area of residence and year of birth (within 1 year) and had to be in a valid job at the age at which the case first left a job for a health related reason (i.e. the matched job was held for at least a year before and after the case left their job). Controls were sampled without replacement from the pool of non-cases, according to a pre-defined alogorithm, so each case and control appeared only once in the final analysis.

Figure 8.1 Subjects included in analyses of leaving a job for a health reason



Footnotes – Please see next page

Foot notes for figure 8.1

1. Job matching criteria – for record of jobs given in question 6 and question 7

adequate match on job title <u>and</u>

a) exact match for age left job (n=1229) <u>or</u>

b) match for age left job within 6 years (n=125) (age left job adjusted to that given in question 6) <u>or</u>

c) age finished job in qu 6 more than 6 years after age left job in qu 7 (n=54) (amend job record in qu 6 to create two jobs – the first finishing at age given in qu 7 and the next starting at an unknown age)

2. Case-control matching criteria – selecting controls

Matched for year of birth (within one year) and area of residence, and in a valid job at the age at which the case first left a job for a health related reason. 4 controls per case were selected, sampled without replacement according to a pre-defined alogorithm.

8.2.2 Categorising health reasons

The reasons given for leaving jobs were assigned to categories based on the main ICD10 chapters. For the frequency analyses 12 categories were used, musculoskeletal disorders, mental health, cardiovascular disease and stroke, respiratory disease, neurological disease, accidents and poisoning, infections, neoplasms, gastro-intestinal disease, diabetes, skin disorders and other. Some of these categories were amalgamated to give adequate numbers for the person-years analyses, producing six main categories, musculoskeletal disorders, mental health, cardio-respiratory disease, neurological disease, accidents and poisoning, and other. Table 8.1 summarises how descriptions of health problems were categorised.

Table 8.1 Categorisation of health problems

Main category	Subcategory	Diagnoses and health problems included
Musculoskeletal		Arthritis. Back, joint, muscular and soft tissue pain. RSI. Other muscular or skeletal disorders and injury
Mental health		Anxiety, stress, depression, chronic fatigue, ME, alcoholism, schizophrenia
Cardiorespiratory	CVS & stroke	IHD, hypertension, PVD, brain haemorrage, stroke, aortic aneurysm
	Respiratory	Asthma, allergy, hay fever, bronchitis, breathing difficulty, farmers lung disease
Neurological		Meningitis, Parkinson's disease, epilepsy, blackouts, effects of brain injury, peripheral neurological problems e.g. carpal tunnel syndrome, diseases of the inner ear and hearing difficulty, diseases of the eye and visual problems
Accidents and poisoning*		Accidents and injuries. Poisoning through chemicals or fumes
Other	Infections	Infections including TB, excluding meningitis
	Neoplasms	Solid neoplasms, lymphoma, leukaemia, myeloma
	Gastro-intestinal	Disorders of the gut and liver, including hernia and haemorroids
	Diabetes	Diabetes and its complications
	Skin disorders	Skin disorders, eczema
	Other	Anaemia, endocrine, metabolic and immunological disorders, HTV, Raynauds syndrome, genitourinary problems e.g. kidney disease, other

RSI = repetitive strain injury, CVS = cardiovascular system, IHD = ischaemic heart disease, PVD = peripheral vascular disease, HTV = hand transmitted vibration
*note- most of this category (90%) comprised accidental injury

8.2.3 Analyses

The incidence rate ratio of first leaving a long-term job, by age, calendar period and area was assessed by a person-years approach using a Poisson regression model. All valid jobs which lasted one year or longer, contributed to the person-years analysis. Information from men who had left a job for a health reason was censored at the age they left their first job. All periods of work were treated as full time jobs. If a job was entered as one combined job e.g. farmer/lorry driver, the period of employment counted once for any job. If the combined job included an agricultural job, the whole period of employment contributed to the analyses on agricultural jobs. Where there was overlap of more than one job, recorded separately, the periods of overlap were identified to ensure that they were only counted once. Risks were estimated for agricultural jobs, non-agricultural jobs and any jobs.

In the case-control part of the analysis, the controls were matched for age and area, and were in a job at the time the case left a job for a health reason. Conditional logistic regression models were used to analyse the data. Risk factors were defined for each member of a matched set in relation to the age at which the case had left his job.

8.3 Leaving work for a health problem – results

8.3.1 Frequency of health related job loss

Out of 10,765 subjects 1502 (14%) reported leaving at least one job for a valid health reason. Among these, 228 subjects had left one or more agricultural jobs.

Table 8.2 shows the numbers of men who left one, two, three or four jobs for a health reason. Some men (21) left both agricultural and non-agricultural jobs; hence they appear in both rows of the table and the sum of men leaving agricultural and other jobs is greater than the total number of subjects. Only four men reported leaving more than one agricultural job for a health reason.

Table 8.2 Frequency of leaving a job for health reasons

	Number of jobs			
Job type	**1**	**2**	**3**	**4**
Agricultural jobs	224	3	1	0
Non-agricultural jobs	1199	84	10	2
All subjects*	1382	104	13	3

*Note – 'all subjects' does not represent sum of agricultural and non-agricultural jobs because some subjects left both types of jobs on one or more occasions

As described in section 8.2.2, health reasons for leaving a job were assigned to categories. Some individuals cited several health reasons for leaving a particular job. In table 8.3, multiple reasons were recorded if the reasons cited fell into more than one of the twelve subcategories listed in table 8.1. The frequency of recording multiple health problems was similar for those leaving agricultural and non-agricultural jobs.

Table 8.3 **The frequency with which several health problems were cited as the reason for leaving an agricultural or non-agricultural job**

	Number of types of health problem mentioned*		
Job type	**1**	**2**	**3**
Agricultural jobs	202 (87%)	25 (11%)	6 (3%)
Non-agricultural jobs	1196 (85%)	198 (13%)	31 (2%)
All subjects	1400 (85%)	204 (12%)	37 (2%)

* out of 12 categories of health problems (in table 8.1)

Table 8.4 shows the breakdown of health reasons for health related job loss in agricultural and other occupations. Overall the most common underlying health reasons were musculoskeletal disorders and mental illness. Mental health reasons and diseases of the cardiovascular system were relatively less frequent and musculoskeletal complaints were relatively more frequent reasons for leaving agricultural jobs compared with other types of work.

Table 8.4 **Frequency of job loss by health reasons**

Health reason	Agricultural jobs left n (%)	Non-agricultural jobs left n (%)	All jobs left n (%)
Musculoskeletal	106 (45%)	433 (31%)	539 (33%)
Mental health	29 (12%)	379 (27%)	410 (25%)
Cardiovascular & stoke	17 (7%)	235 (17%)	252 (15%)
Respiratory	24 (10%)	68 (5%)	93 (6%)
Neurological	19 (8%)	100 (7%)	119 (8%)
Accidents & poisoning	30 (13%)	165 (12%)	195 (12%)
Infections	4 (2%)	30 (2%)	35 (2%)
Neoplasms	11 (5%)	45 (3%)	56 (4%)
Gastrointestinal	10 (4%)	56 (4%)	66 (4%)
Diabetes	3 (1%)	24 (2%)	27 (2%)
Skin disorders	1 (0%)	22 (2%)	23 (1%)
Other	16 (7%)	88 (6%)	104 (6%)

Some episodes have been counted more than once if they were attributed to multiple health problems.

8.3.2 Incidence of health related job loss

As described in previous sections, in order to estimate an incident rate for health-related job loss, data from all subjects who reported jobs they had held for a year or longer were used. 10 599 subjects provided information that could contribute to the person-years analysis. Of these 1408 had left at least one long-term job for a health reason. In 94 of the men who reported leaving a job for a health reason, no link could be made with a long-term job contributing person years, either because information about the job left was incomplete or did not match that of a long-term job, or because the job was left before the age of 17 or after the age of 64.

The rate of health-related job loss by age group and calendar period for agricultural jobs and non-agricultural jobs was calculated as jobs left per 1000 person years (i.e. total number of jobs left in each age stratum or calendar period (x1000) divided by person years contributing to each respective stratum). Tables 8.5 and 8.6 show that there was an increasing rate of health-related job loss with age and increasing tendency to report job loss in more recent time periods, though the pattern was less clear for agricultural jobs and the number of jobs left per 1000 person years was lower. The mean rates of job loss for all ages and time periods for agricultural, non-agricultural and all jobs were 2.4, 4.9 and 4.3 jobs per 1000 person years, respectively.

Table 8.5 Incidence rate by age and calendar period of health related job loss (per 1000 person years) from agricultural jobs

	Calendar Period									
Age group	**1949-59**	**1960-64**	**1965-69**	**1970-74**	**1975-79**	**1980-84**	**1985-89**	**1990-94**	**1995-99**	**2000-03***
16-24	0.8	1.4	0.3	0.8	0.8	1.1	1.5	2.5	1.8	0.0
25-29	0.0	0.7	1.1	1.0	2.5	0.6	1.8	4.7	1.1	3.0
30-34		0.0	0.0	1.7	0.0	0.6	1.9	3.1	3.2	9.0
35-39			0.0	0.8	1.1	0.0	1.3	1.3	3.2	10.2
40-44				0.0	2.3	1.7	0.5	3.9	2.0	4.4
45-49					0.0	1.5	3.9	2.6	4.0	9.1
50-54						0.0	3.9	5.1	4.9	4.4
55-59							10.9	4.1	4.2	5.5
60-64								11.3	9.6	16.8

**data up to June 2003*

Table 8.6 **Incidence rate by age and calendar period of health related job loss (per 1000 person years) from non-agricultural jobs**

	Calendar Period									
Age group	**1949-59**	**1960-64**	**1965-69**	**1970-74**	**1975-79**	**1980-84**	**1985-89**	**1990-94**	**1995-99**	**2000-03***
16-24	1.2	2.0	1.7	2.0	1.5	1.6	2.5	5.6	5.9	6.2
25-29	4.9	1.3	0.6	1.7	0.9	1.8	2.2	5.2	8.7	4.0
30-34		0.0	0.2	1.4	2.6	1.8	2.3	4.5	4.5	7.6
35-39			0.0	1.3	1.1	1.4	2.5	4.1	6.2	6.0
40-44				2.4	1.7	2.1	3.0	5.9	8.3	10.2
45-49					2.4	3.0	4.6	8.4	8.4	9.1
50-54						2.5	8.2	12.7	15.0	15.7
55-59							13.7	19.6	18.0	21.4
60-64								19.1	19.9	26.7

**data up to June 2003*

Table 8.7 shows the relative risk of losing a job for any health reason, by age group, calendar period and area. The risk of job loss was highest in older age groups. The incidence rate ratio (IRR) for health-related job loss in the 60-64 age group was 3.5 times that in the 16-24 age group for all jobs left. The trend of increasing risk of health-related job loss with age appeared to start around the age of 40 for non-agricultural jobs. The trend was less clear in men leaving agricultural jobs, though there was a significant increase in risk in the oldest age group. The results also suggested a tendency for reported job loss to occur more frequently in more recent time periods.

Some variation by area was apparent for non-agricultural jobs, with a higher rate of health-related job loss in Lincolnshire, (IRR 1.3 compared to the Welsh Borders).

Table 8.7 Risk of first health-related job loss by age, calendar period and area

	Agricultural jobs	Non-agricultural jobs	All jobs
Risk factor	**IRR* (95% CI)**	**IRR* (95% CI)**	**IRR* (95% CI)**
Age group			
16-24	1.0	1.0	1.0
25-29	1.3 (0.7 –2.4)	0.9 (0.6 –1.2)	0.9 (0.7 –1.2)
30-34	1.2 (0.6 –2.3)	0.8 (0.6 –1.1)	0.9 (0.7 –1.2)
35-39	1.1 (0.6 –2.1)	0.8 (0.6 –1.1)	0.9 (0.67 –1.1)
40-44	1.1 (0.6 –2.2)	1.1 (0.8 –1.5)	1.2 (0.9 –1.6)
45-49	1.7 (0.9 –3.2)	1.4 (1.0 –1.8)	1.5 (1.2 - 2.0)
50-54	1.8 (0.9 –3.4)	2.3 (1.7 –3.0)	2.3 (1.8 –3.0)
55-59	1.6 (0.8 –3.2)	3.0 (2.2 –4.0)	2.9 (2.2 –3.8)
60-64	3.9 (1.9 –7.8)	3.3 (2.4 –4.6)	3.5 (2.6 –4.7)
Calendar period			
1949-1959	0.2 (0.0 –0.6)	0.2 (0.1 –0.3)	0.2 (0.1 –0.3)
1960-64	0.3 (0.1 –0.6)	0.2 (0.2 –0.4)	0.3 (0.2 –0.4)
1965-69	0.1 (0.0 –0.3)	0.1 (0.1 –0.2)	0.1 (0.1 –0.2)
1970-74	0.2 (0.1 –0.5)	0.3 (0.2 –0.4)	0.2 (0.2 –0.3)
1975-79	0.2 (0.1 –0.5)	0.2 (0.2 –0.3)	0.2 (0.2 –0.3)
1980-84	0.2 (0.1 –0.3)	0.3 (0.2 –0.3)	0.2 (0.2 –0.3)
1985-89	0.4 (0.2 –0.6)	0.4 (0.3 –0.5)	0.4 (0.3 –0.5)
1990-94	0.6 (0.4 –0.9)	0.8 (0.7 –0.9)	0.8 (0.6 –0.9)
1995-99	0.5 (0.4 –0.8)	0.9 (0.7 –1.0)	0.8 (0.7 –1.0)
2000-2004	1.0	1.0	1.0
Area			
Welsh Borders	1.0	1.0	1.0
Devon	1.2 (0.9-1.7)	1.0 (0.9-1.2)	1.1 (0.9-1.2)
Lincolnshire	1.1 (0.7-1.5)	1.3 (1.1-1.5)	1.3 (1.1-1.4)

*Incidence rate ratio. Derived from person-years approach and Poisson regression model. For each job category all risk estimates mutually adjusted

The relative risk of losing a job by age group, calendar period and area was estimated for specific types of health problem. Table 8.8 shows that the age-related and temporal pattern of job loss varied with the type of health problem reported. The increasing trend with more recent time period was restricted to musculoskeletal and mental health reasons and accidents and poisoning. The increased risk with age occurred with all main categories of reasons except accidents and poisoning, but the strongest association was with cardio-respiratory disease followed by neurological disease. Among agricultural workers the risk of health related job loss was significantly lower than for other occupations for all types of health reasons and particularly for mental health.

In similar analyses restricted to men in agricultural jobs, overall trends were similar to those shown in table 8.8, but the small number of subjects made it difficult to draw conclusions.

Table 8.8 Risk of first loss of any long-term job by health reason, age, calendar period, area and occupation

	Musculoskeletal n=468	Mental health n=358	Cardio-respiratory n=293	Neurological N=99	Accidents & poisoning n=163	Other n=253
	IRR* (95%CI)	IRR* (95%CI)	IRR* (95%CI)	IRR* (95%CI)	IRR* (95%CI)	IRR* (95%CI)
Age group						
16-24	1.0	1.0	1.0	1.0	1.0	1.0
25-29	1.2 (0.7-1.9)	0.7 (0.4-1.4)	0.7 (0.4-1.5)	2.3 (0.6-8.3)	0.8 (0.5-1.5)	0.8 (0.5-1.5)
30-34	1.1 (0.6-1.7)	1.2 (0.7-2.2)	0.3 (0.1-0.9)	2.1 (0.6-8.2)	0.8 (0.4-1.4)	0.4 (0.2-0.9)
35-39	0.8 (0.5-1.4)	1.0 (0.6-1.9)	0.7 (0.3-1.5)	2.4 (0.6-9.3)	0.6 (0.3-1.2)	0.7 (0.4-1.3)
40-44	1.1 (0.7-1.8)	1.3 (0.8-2.4)	1.2 (0.6-2.5)	4.1 (1.1-15.0)	0.7 (0.4-1.3)	1.3 (0.7-2.3)
45-49	1.5 (0.9-2.4)	1.6 (0.9-2.8)	2.1 (1.1-4.2)	5.5 (1.-20.2)	0.8 (0.4-1.5)	1.1 (0.6-2.0)
50-54	2.2 (1.4 - 3.6)	2.4 (1.3-4.2)	5.2 (2.7-10.0)	6.9 (1.9-25.4)	0.9 (0.5-1.8)	2.1 (1.2-3.8)
55-59	2.7 (1.7-4.3)	2.5 (1.4-4.4)	9.6 (4.9-18.5)	10.5 (2.8-39.0)	0.9 (0.4-1.8)	2.3 (1.3-4.4)
60-64	3.5 (2.1-5.9)	1.6 (0.8-3.3)	15.3 (7.6-30.7)	7.8 (1.8-34.5)	0.4 (0.1-1.6)	5.2 (2.7-9.9)
Calendar period						
1949-1959	0.0 (0.0-0.2)	0.0 (0.0-0.3)	0.8 (0.3-2.3)	0.9 (0.1-5.7)	0.1 (0.0-0.6)	0.4 (0.1-1.1)
1960-64	0.1 (0.0-0.3)	0.1 (0.0-0.3)	0.6 (0.2-1.8)	0.2 (0.0-2.1)	0.4 (0.2-1.1)	0.5 (0.2-1.1)
1965-69	0.1 (0.0-0.2)	0.0 (0.0-0.1)	0.4 (0.1-1.2)	0.3 (0.1-1.4)	0.2 (0.1-0.6)	0.3 (0.1-0.7)
1970-74	0.1 (0.0-0.2)	0.2 (0.1-0.4)	0.7 (0.3-1.6)	0.3 (0.1-1.2)	0.3 (0.1-0.7)	0.4 (0.2-0.9)
1975-79	0.2 (0.1-0.3)	0.2 (0.1-0.3)	0.6 (0.3-1.4)	0.5 (0.2-1.3)	0.4 (0.2-0.9)	0.2 (0.1-0.4)
1980-84	0.2 (0.2-0.4)	0.1 (0.1-0.2)	0.7 (0.4-1.3)	0.2 (0.1-0.6)	0.3 (0.1-0.6)	0.2 (0.1-0.5)
1985-89	0.4 (0.2-0.5)	0.2 (0.2-0.4)	0.8 (0.5-1.3)	0.4 (0.2-0.9)	0.5 (0.3-1.0)	0.5 (0.3-0.9)
1990-94	0.7 (0.5-0.9)	0.6 (0.5-0.9)	0.9 (0.6-1.4)	0.7 (0.4-1.4)	1.0 (0.6-1.8)	0.9 (0.6-1.3)
1995-99	0.8 (0.6-1.1)	0.8 (0.6-1.0)	1.0 (0.7-1.3)	0.7 (0.4-1.2)	1.1 (0.6-1.9)	0.7 (0.5-1.1)
2000-2004**	1.0	1.0	1.0	1.0	1.0	1.0
Area						
Welsh Borders	1.0	1.0	1.0	1.0	1.0	1.0
Devon	0.9 (0.7-1.1)	1.1 (0.8-1.3)	1.2 (0.9-1.6)	1.1 (0.7-1.8)	1.5 (1.1-2.2)	1.2 (0.9-1.6)
Lincolnshire	1.2 (0.9-1.5)	1.1 (0.8-1.4)	1.5 (1.1-2.0)	1.2 (0.7-2.0)	1.8 (1.2-2.8)	1.3 (1.0-1.8)
Occupation						
Agricultural vs other	0.7 (0.6 – 0.9)	0.3 (0.2-0.4)	0.4 (0.3-0.6)	0.7 (0.4-1.1)	0.5 (0.3-0.8)	0.6 (0.4-0.8)

n= number of cases * IRR = incidence rate ratio. Derived from person-years approach and Poisson regression model. ***data up to June 2003*

8.3.3 Risk factors for health related job loss

The case control part of the analysis allowed us to assess the impact of potential risk factors on health related job loss. Information in question 6 (the question on occupational history) provided data on employment status and occupational exposures (whether an average working day included any of nine specified activities).

We included 1408 cases and 5632 matched controls, selected as described in section 8.2. Risk factors were defined for each matched set in relation to the age at which the case had left his job. A conditional logistic regression model was used to estimate odds ratios. Table 8.9 compares some characteristics of cases and controls, giving risk estimates before and after mutual adjustment. The four occupational activities for which results are presented are those which showed statistically significant ($p < 0.05$) positive associations with job loss for any health problem, and which might plausibly be made difficult by impaired health. For any job, important risk factors were employment status, shift work and physical activity, particularly lifting. There was also a decreasing trend with duration of experience in a job. Men who were employed were twice as likely to leave work for a health reason as those who were self-employed.

Those in agricultural jobs were less likely to leave for any health reason (OR 0.5, 95% CI 0.4-0.6) compared to those in other types of work (table 8.9). When categories of health reason were looked at separately, the odds ratios were significantly lower for mental health and cardiorespiratory reasons (table 8.10). Employment status was the strongest risk factor for leaving any job for a mental health reason for all jobs left. An important risk factor for leaving any job for musculoskeletal reasons was lifting or moving heavy weights. Prolonged kneeling or squatting, was also associated with increased risk, as was shift work which appeared to be a risk factor for each health outcome category. These exposures and use of powered tools (in analyses not shown) were also significantly associated with job loss because of accidents and poisoning. Working in a noisy environment was associated with job loss because of neurological disorders, which included hearing problems.

Table 8.9 Characteristics of cases and controls and association between risk factors and job loss for any health problem

	% controls	% cases	OR (95% CI) unadjusted	OR (95% CI) adjusted**
Type of work experience				
Employed (vs self employed)	62	76	2.1 (1.8-2.4)	2.0 (1.7-2.4)
Agricultural job (vs non-agricultural)	25	14	0.5 (0.4-0.6)	0.6 (0.5-0.7)
Duration of experience*				
1-5 years	26	27	1.2 (1.0-1.5)	1.1 (0.9-1.4)
6-15 years	29	32	1.3 (1.1-1.6)	1.2 (1.0-1.5)
16-25 years	20	18	1.1 (0.9-1.3)	1.0 (0.8-1.2)
26 or more years	25	23	1.0	1.0
Work activities in an average day				
Shift work	12	22	2.0 (1.7-2.3)	1.5 (1.3-1.8)
Lifting/moving heavy weight >25kg	49	56	1.3 (1.2-1.5)	1.5 (1.3-1.8)
Kneeling or squatting for >1 hour	21	30	1.6 (1.4-1.9)	1.3 (1.0-1.6)
Working with hands above shoulder height for > one hour	13	20	1.7 (1.5-2.0)	1.3 (1.0-1.6)

*number of years in the selected job. Controls censored at the time matched case left their job
**mutually adjusted. Total cases and controls =7040

Table 8.10 Risk factors associated with job loss for selected types of health problems

	Musculo-Skeletal n=2340	Mental Health n=1790	Cardio-respiratory n=1465	Accidents and poisoning n=815
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Type of work experience				
Employed (vs self employed)	2.1 (1.6-2.8)	2.7 (1.9-3.8)	1.7 (1.2-2.4)	2.0 (1.3-3.3)
Agricultural job (vs non-agricultural)	0.8 (0.6-1.1)	0.4 (0.2-0.6)	0.5 (0.3-0.8)	0.7 (0.4-1.3)
Duration of experience*				
1-5 years	1.0 (0.7-1.4)	0.8 (0.6-1.3)	1.5 (1.0-2.3)	1.3 (0.6-2.7)
6-15 years	1.0 (0.7-1.3)	0.9 (0.6-1.3)	1.8 (1.2-2.6)	2.4 (1.2-4.7)
16-25 years	0.8 (0.6-1.2)	0.7 (0.5-1.1)	1.0 (0.6-1.5)	0.9 (0.4-2.0)
26 or more years	1.0	1.0	1.0	1.0
Work activities in an average day				
Shift work	1.5 (1.1-2.0)	1.5 (1.1-2.1)	1.4 (1.0-2.1)	2.3 (1.4-3.6)
Lifting/moving heavy weight >25kg	2.4 (1.9-3.2)	0.8 (0.6-1.1)	1.6 (1.1-2.2)	1.7 (1.1-2.6)
Kneeling or squatting for >1 hour	1.7 (1.3-2.2)	1.1 (0.7-1.6)	1.2 (0.8-1.9)	2.1 (1.2-3.4)
Working with hands above shoulder height for > one hour	1.3 (0.9-1.7)	1.4 (0.9-2.2)	1.3 (1.8-2.0)	1.4 (0.8-2.4)

*number of years in the selected job. Controls censored at the time matched case left their job
ORs mutually adjusted

8.3.4 Subsequent employment

The occupational histories of cases from the person-years analysis were reviewed to establish how many subsequently returned to long-term employment (i.e. reported a subsequent job held for a year or longer). A modified Cox's regression analysis was used to assess whether the probability of subsequent employment was influenced by the type of job left (agricultural or non-agricultural) and by type of health problem, age, area and calendar period.

Table 8.11 shows associations with potential risk factors for further long-term employment after first episode of health-related job loss. Both age and calendar period were risk factors, with the oldest and those having left a job more recently being less likely to have achieved further employment.

There was little difference according to the main health categories included in the analysis. Health problems in the neurological category and accidents were not included in the analysis because of small numbers, but frequency analyses on all subjects suggested that men leaving a job for a neurological reason were less likely to obtain further long-term employment, and those leaving because of an accident were more likely to, compared to other reasons.

The type of job left i.e. an agricultural versus a non-agricultural job, did not affect the proportion who subsequently obtained long-term employment (table 8.11). Of the 1408 men who had left job, 862 (61%) obtained another long-term job. Most (88%) of those who obtained subsequent employment did so within a year, and almost all (98%) within four years.

Table 8.11 Predictors of further long-term employment after initial health related job loss in 1408 men

Predictor	Number of men	Number (%) who achieved further long-term employment	PR[a] (95% CI)	
Age at initial job loss (years)				
17-24	123	121 (98%)	2.4	(1.8 – 3.3)
25-34	211	185 (88%)	2.2	(1.7 – 2.9)
35-44	261	187 (72%)	1.9	(1.5 – 2.5)
45-54	457	251 (55%)	1.5	(1.2 – 1.9)
55-64	356	118 (33%)	1.0	
Year of initial job loss				
1953-74	117	116 (99%)	1.6	(1.2 – 2.2)
1975-84	129	110 (85%)	1.5	(1.2 – 2.1)
1985-89	154	111 (72%)	1.5	(1.1 – 2.0)
1990-94	339	201 (59%)	1.4	(1.1 – 1.7)
1995-99	396	219 (55%)	1.4	(1.1 – 1.7)
2000-03	273	105 (38%)	1.0	
Health problem leading to initial job loss[b]				
Musculoskeletal	468	280 (60%)	0.9	(0.8 – 1.2)
Mental health	358	235 (66%)	1.0	(0.8 – 1.3)
Cardio-respiratory	293	148 (51%)	0.9	(0.7 – 1.1)
Other	491	306 (62%)	0.9	(0.7 – 1.1)
Type of job left				
Agriculture	203	124 (61%)	1.0	(0.8 – 1.2)
Other	1205	738 (61%)	1.0	

[a] All risk estimates are mutually adjusted
[b] Risks presented compare those with health problem against those without.
Number of men total more than 1408 as some reported more than one health problem for their job left.

8.4 Summary of main findings

A high proportion of men (14%) claimed to have left at least one job for a health reason, over a working lifetime. The most common complaints were musculoskeletal disorders followed by mental health problems.

The risk of leaving an agricultural job was about half that of leaving a non-agricultural job (2.4 compared to 4.9 jobs per 1000 person years in the cohort analysis and OR 0.5 in the case control analysis). This lower risk of leaving a job applied to all categories of health problems, even those known to be prevalent in farming and forestry, such as musculoskeletal disorders and accidental injury. For agricultural jobs, musculoskeletal complaints and respiratory disease were relatively more frequent reasons given for leaving compared with other types of work, and mental health reasons and diseases of the cardiovascular system were relatively less frequent.

For all occupations, including agricultural work, there was a trend suggesting a higher risk of job loss in more recent time periods and an increased risk in older age groups. Employed workers had approximately twice the risk of health related job loss of the self-employed, but this but did not account for much of the difference between agricultural workers and non-agricultural workers.

Of all those who left a job for a health reason, 61% had obtained subsequent long-term employment by the time of the survey, and in most of these it was within a year of their initial job loss. When men left agricultural jobs because of their health they were just as likely to find subsequent employment as those leaving non-agricultural jobs.

8.5 Strengths and limitations of the study

The study collected information from a community-based sample of men and explored how health problems impacted on their ability to keep a job and whether they found subsequent long-term employment. The depth and breadth of information we gathered was not available from other sources. The data also allowed us to compare the risk of leaving agricultural jobs with other jobs.

However as discussed previously, the potential impact of response bias needs consideration. The questionnaire was about health and work and it is quite possible that men who had had health problems that caused them to leave a job responded preferentially. Thus the frequency of leaving at least one job for a health reason (14% of respondents) may be an overestimate. However, it is unlikely that the pattern of job loss we observed was significantly influenced by responder bias because for this to be the case, those with particular types of health problems would have had to respond preferentially. Also the comparison of risks between agricultural and non-agricultural jobs left, (using a person-years approach, and findings from the case control analysis) was unlikely to be importantly influenced by response bias unless there was a big differential response by risk factors. For example, to affect the pattern of job loss by birth cohort the influence of health related job loss on whether a person answered the questionnaire would have had to be systematically different across age bands, and this seems unlikely. Selection bias could have operated to some extent with only the fittest entering a physically demanding job such as agriculture, but some non-agricultural jobs are also physically demanding so the healthy worker effect could apply to some extent in both categories of jobs and would be less relevant for mental health problems.

It is possible that men recalled details of jobs left in more recent calendar periods most readily, and this could account for the increasing trend in risk of job loss over time. However the trend did not apply equally to all categories of health problems, suggesting that non-differential recall bias was not the whole reason for this observation.

When jobs left (question 7) were matched to those given in the job history (question 6) there were discrepancies. Some subjects had difficulty recalling ages and/or their occupational history appeared incomplete. These included 6% of those who had left a job but could not be included in risk analyses because of no matching job in their occupational history. These subjects were assumed to have left a job that they had held for less than one year. Even if a proportion of these men had left longer-term jobs their inclusion would be unlikely to influence the results importantly because of the relatively small numbers. Also, subjects who had not left a job for health reasons sometimes gave incomplete job histories. It is probable that many of the gaps in information were because periods of employment, or unemployment, were for less than one year. If this was not the case, then we may have underestimated the person years at risk. However, given that the data provided nearly a million person years at risk, there would need to have been a lot of missing data to make any discernable difference.

Some subjects reported a combination of health reasons for leaving a job. In particular, 14% of all subjects listed health reasons that fell into two or more of the 12 categories of health problem we distinguished. In these cases it was difficult to know if one health problem was dominant, so we included all of them in the analyses. It seemed reasonable to assume that all health reasons significantly contributed to the subject leaving their job, even if they were not the only reason.

8.6 Discussion of results

Age

The increasing trend in health related job loss by increasing age group was not surprising given that many health problems are age related, and the difference in trends according to health reason, supports this. A steep trend was observed for cardio-respiratory reasons, whereas there was no particular age pattern for those leaving a job because of an accident or poisoning. Among agricultural workers the trend with increasing age was less marked than for non-agricultural jobs, although the risk of agricultural workers leaving after the age of 60 was high. For men in certain non-agricultural occupations there are financial benefits attached to leaving a job earlier, such as early retirement packages, and this may explain in part why the risk of health related job loss apparently increased quite steeply from around the age of 50 years in non-agricultural jobs.

Older age at initial job loss was associated with less success in obtaining subsequent long-term employment. This could be explained by a several factors such as the nature of health problems and consequent inability to work, the difficulty many older men have in finding acceptable long-term employment if they want it because of reluctance of employers to take on older workers, and for some, adequate financial support from an early retirement package. In a prospective cohort study of middle aged Finnish construction workers, identified risk factors for long-term unemployment (>24 months) were older age group, previous unemployment, being single, current smoking, high alcohol consumption, frequent stress symptoms, mental disorders (mainly neurosis) and medical conditions, particularly peptic ulcer, allergic eczema and ocular diseases.[349]

Calendar period

For other occupations, the risk of job loss tended to increase with more recent calendar period. While it is possible that to some extent this arose from better recall in near time, the differences in patterns by health reason suggest that this is not the whole explanation.

The clear time trend for musculoskeletal reasons and similar increase over a more recent calendar period for mental health problems are consistent with social security statistics. In Britain claims for sickness and invalidity benefit for back incapacity rose eight-fold from the 1950s to the 1990s.[350] More recent data obtained on request from the Department of Work and Pensions (DWP) suggest that between 1996 and 2004 claims for incapacity benefit and severe disablement allowance for musculoskeletal disorders have plateaued (at around half a million claims per year), but claims relating to mental and behavioural disorders have steadily increased over that time period, by more than 50% (from 648 to 1025 thousand claims per year).

The question arises as to whether the increases in job loss attributed to these diagnostic groups are because of a true increase in pathology or related to social and cultural attitudes about acceptable reasons for not working and/or the medical profession supporting those attitudes. Another factor could be a harsher work environment with employers more reluctant to 'carry' less productive workers.

For the most common mental health and musculoskeletal problems, such as stress and back pain, diagnosis depends on self-report and it is often impossible to identify underlying pathology, so it is difficult to ascertain the reason with certainty. However, psychosocial reasons are probably important. A major contributor to sickness absence for musculoskeletal reasons is back pain.[139] A number of studies have identified psychosocial or non-physical work related factors associated with back pain, including work dissatisfaction.[159, 160, 162, 163, 165, 333] While physical activity and lifting are associated with back pain,[328, 333] in general the amount of heavy physical work has decreased over the years,[141] so it is unlikely that this could account for the increase in work related illness. Many mental health reasons given for leaving a job in our study were stress related. It is feasible that the increasing trend in mental health problems and their use as a reason for leaving work was related, primarily, to changes in psychosocial factors, together with increasing acceptability as a valid health reason for not working.

The calendar period of initial job loss was an independent risk factor for obtaining subsequent long- term employment with a higher return from earlier periods. This could be partly explained by the time required to find another long-term job, but most men who did get a subsequent job did so within a short period of time period. Therefore it seems probable that the 39% who did not obtain subsequent long-term employment either were not able to, because of ongoing health problems; did not wish to continue looking for employment, possibly because of age or adequate financial support; or could not find a suitable job. The latter may be related to changes in economic climate and types of job available.

Employment status

Employment status was a significant risk factor for job loss and was only marginally affected by adjusting for other factors. There are a number of possible reasons why self-employed workers were less likely to stop working. Dedication and finance are probably the most important. Self-employed workers are unlikely to receive financial support if they stop working, unless they have made sufficient contributions to an insurance scheme. Also for many self-employed workers, there is no one else to do their job, so pressure to continue working would be more than for an employee in a company where someone else can take over. Also, skilled, motivated men used to working for themselves and probably doing something they have actively chosen to do, may have difficulty finding desirable alternatives, so the incentive to carry on working would be higher than for some, possibly less motivated, employees.

For some employees, leaving a job for a health reason may not be determined by personal choice, particularly if there is insufficient flexibility within an organisation to find tasks they are able to do. Job retention for disabling hip or knee disease has been found to be poorer in small companies (less than ten employees), than in larger organisations.[351] In the rural communities we studied, it was likely that many people had worked in small organisations, so this could have contributed to the high risk in employees.

On the other hand, many public sector jobs were also in our sample. Employees in larger public organisations are likely to be given reasonable support when they have difficulties because of health problems. However this does not stop them leaving for health reasons, for example police and teachers have a particularly high risk.[352] In most public sector jobs there are accepted systems, precedents and financial arrangements for severing jobs on health grounds so culture within the organisation and financial benefits probably contribute to the relatively high health related job loss among certain public sector employees.

Self-employed people may have some flexibility to adjust their work to adapt to health problems, but probably not without financial loss or need for additional support, though this element of choice could conceivably be a factor that allows them to continue to work in the same occupation.

Agricultural work

Compared to all other occupations agricultural workers were less likely to leave their job for health reasons. The risk was significantly lower for agricultural work across all health categories (except neurological because the numbers were too small to reach statistical significance). The variation in relative risk between health categories was compatible with agricultural work activities e.g. musculoskeletal problems were relatively more common.

It did not seem that farm jobs left were under-reported to a greater extent than non-farm jobs. In fact farmers were more likely to have answered the question to inform us of health problems that had in fact not led to job loss for example, those that included comments such as 'still struggling on', were not counted as leaving a job.

The risk analyses used person-years in agricultural and non-agricultural jobs as a denominator. Job history was not complete for all subjects and it is possible that there was a higher proportion of missing data for non-agricultural jobs, thus leading to an underestimate of person-years at risk and an overestimate of risk, but it is hard to imagine that the differential in under-reporting was large enough to account for the results we found.

Calculation of person-years required classification of jobs into agricultural and non-agricultural. Men who worked part- time in agriculture at the same time as working in a non-agricultural job e.g. farmer and lorry driver contributed to (full time) agricultural person-years and not to non-agricultural person-years. Therefore agricultural person years at risk were artificially increased. In 1991 about 10% of agricultural jobs were part- time, though some of these were not combined with other non-agricultural work. Even a 10% difference in the denominator would have made very little difference to the risk estimates we found. So it is unlikely that we have grossly underestimated the relative risk of job loss in agricultural workers.

It is unlikely that the lower risk of health related job loss was because agricultural workers had fewer health problems. A survey of farmers in England and Wales found that almost one third reported health problems that interfered with their work.[14] The pattern of job loss by health reason was consistent with recognised health problems. We found that when agricultural jobs were left for health problems, musculoskeletal disorders were the most frequent reason. This is consistent with a Finnish survey which found that self- reported moderate or poor work ability was due to somatic disease or factors associated with ageing in 75% of their sample of farmers, and musculoskeletal problems were the most common chronic disorders.[15]

Data from this study (chapter 7) and other data[83] suggested that the frequency of cardio-respiratory ill health and mental health in men who have worked in agriculture is not very different from those who have not. Accidental injury is thought to be higher in agricultural workers[16] yet we found that for each category of health reason agricultural workers were less likely to leave their job.

The fact that the proportion of agricultural and non-agricultural workers who obtained subsequent long-term employment was the same suggests that the level of disability or illness or differences in the job market were probably not major factors contributing to the difference in risk.

A large proportion of agricultural workers are self-employed and the probable economic and cultural reasons for a low risk of health related job among the self-employed apply to agricultural work. However employment status did not account for the low risk of job loss among agricultural workers compared to other occupations.

As discussed above, the ability to modify job tasks within a job may account for some job retention, but in agricultural workers this is unlikely to be without difficulty. There is no good evidence that this was a significant factor, but anecdotal comments from farmers responding to the questionnaire such as 'gave up sheep dipping', or 'stopped driving a tractor' suggest that farmers are occasionally forced to adapt. A farmer who gave up tractor driving because of back pain, but carried on farming in other ways, would not have been included as a case in our analyses, but a lorry driver giving up lorry driving for a similar reason would. However, this only applied to a few subjects and was not a major factor in the differences in job loss.

Perhaps the more pressing question to address is not so much why the low risk in farmers but why the relatively high risk in other occupations?

For any job, the reasons for leaving work are likely to be complex and could involve a mixture of social, economic, occupational and health reasons. As discussed, financial incentives play a role in some situations, for example retirement options for police officers.

Work factors have been shown to contribute to sick leave, and similar factors may be important in leaving a job. For example work dissatisfaction and job stressors have been associated with taking time off for back pain and the availability of co-worker support increased the risk of long-term sick leave for this reason.[328]

Psychosocial and cultural differences are likely to be important, for example mental health problems appear to be less of an acceptable cultural norm in agricultural work than other occupations. In one study farmers were less likely than non-farmers, to present to general practitioners with mental health symptoms prior to committing suicide although they did consult for physical complaints.[13] So perhaps health beliefs are important in influencing attitudes towards health and work.

The ease with which a sickness certificate may be obtained from a general practitioner for problems such as pain and stress, which are difficult to dispute, may exacerbate the problem of low threshold for fitness to work. There is no immediate benefit to GPs in refusing to issue a sickness certificate and it is difficult for employers to dispute the problem once a sickness certificate has been issued. Even if a GP suspected incompatibility with the work environment to be the cause of consultation, patient confidentiality would prevent him or her investigating the matter.

8.7 Conclusions

Despite the relatively hazardous nature of agricultural work, long hours worked, fitness required to carry out most agricultural work and evidence of a falling agricultural workforce, the results of this study suggest that the risk of leaving an agricultural job for a health reason was less than for other occupations. The relatively low risk of health related job loss in agricultural workers was probably not because of better health of men working in agriculture, but more to do with the working environment in other occupations, an environment that leads individuals to feel that work adversely affects their health or that their health is not good enough to continue in the same job.

The relative risk of leaving a job for mental health reasons was particularly low in agricultural workers compared to other jobs, and this is the diagnostic category of particular concern in terms of increasing benefit claims and working days lost. The underlying cause may be a social and cultural attitude that personal rights exceed individual responsibility. However some further work might usefully take place in defined occupations to establish causes of stress, for example, the importance of work factors such as demands and lack of support and personal factors including competence.

While many subjects found further work quite quickly, around 40% did not. Further research should focus on this minority to investigate the reasons why those of working age were not able to obtain suitable subsequent employment.

Health related loss of job was less frequent in agricultural workers than in other jobs. However of those that left, nearly half cited a musculoskeletal cause and the risk did not appear to be decreasing with time despite machinery and interventions to reduce heavy lifting and physical work. As in other occupations, psychosomatic factors may play a role. A repeated survey some years hence to look at patterns of health related job loss in agriculture and other selected occupations might provide further insight into this.

CHAPTER 9: SUMMARY OF RESEARCH FINDINGS

The study described in this thesis set out to investigate the effects of exposure to occupational hazards on health, and considered impacts of health on ability to work. This chapter is a brief summary of the strengths and limitations of the study, and the principal findings that have been discussed in previous chapters.

9.1 Study Strengths

The study was large with a high number of respondents so we were able to analyse the data in some detail with reasonable power. For instance, almost 5000 accidents at work were reported in total, with over 1700 in agricultural work .

Use of a community sample meant that there was the potential to collect information from men who had worked in agriculture at any time during their lives. This was valuable because some men may have left agricultural work because of the health problems in which we were interested, and others may have experienced health problems but left for other reasons. Also, we were able to compare the prevalence of health outcomes with those in non-agricultural workers. Many of the longer-term symptoms that had been reported to be associated with OPs occur commonly in the population, and it was helpful that we could assess the relative frequency in users and non-users of OPs and other pesticides.

The availability of data on lifetime job history meant that we were able to estimate rates by occupation, which we did for accidents and health related job loss.

9.2 Study Limitations

A potential limitation in interpreting study results was the low response rate, which could have led to bias if responders differed from non-responders in relation to the prevalence of health outcomes. This was more likely to be an issue for direct questions about symptoms linked to exposure. In order to assess the possible magnitude of response bias we looked at the frequency of symptoms following pesticide use and accidents at work reported by first time and late responders. The results suggested that the impact of response bias was probably small.

It is less likely that response bias had much impact on the association between symptoms and possible risk factors. For example, for risk factors associated with symptoms following pesticide use this would imply selective non-response of pesticide users without symptoms but with exposure to risk factors.

Health outcomes and past exposure to risk factors were both assessed by questionnaire raising the possibility of information bias. Errors in the assessment of exposures may have been differential with respect to health outcomes (i.e. symptoms prompting more complete recall of exposure), or non-differential. The first would have the effect of increasing the association between exposure and symptoms if it occurred to any extent. The questions about exposure and symptoms were not linked in the questionnaire, although they may have been linked in the responder's mind, irrespective of study design. Non-differential errors in the reporting of exposures would bias risk estimates towards the null.

Lack of specificity of exposure information was a shortcoming in some situations. In order to avoid complicating the question on exposure to pesticides at work, we did not ask about chemical names of pesticides used. Therefore we could not be certain what proportion of the sheep dips and insecticides used were OPs. Men who reported acute symptoms after pesticide use were asked about the chemicals used, but even for this subgroup, the information was not complete or precise enough to be useful.

For exposure to noise, questions on the use of ear protectors or how frequent and for how much of the day noise exposure occurred were not included in the questionnaire. If anything, the resultant misclassification of exposure would tend to obscure associations with deafness. However, we still found a positive association between hearing difficulty and years of work in a noisy environment.

Assessing the duration of long-term symptoms is difficult in this type of study. Most of the neuropsychiatric outcome measures we used were current symptoms (past month or past week). While these could indicate chronic symptoms, they may not necessarily do so. An advantage of asking about current symptoms was that it should have minimised errors of recall.

A difficulty in many cross-sectional surveys is the direction of cause and effect. For example, tendency to somatise might predispose to symptoms following pesticide exposure but it is also possible that pesticide poisoning could cause chronic somatic symptoms. Similarly, agricultural work might protect against hay fever, but it is also possible that men with hay fever tend not to enter agricultural work. To resolve these uncertainties would require a longitudinal study.

9.3 Summary of results

Several aspects of health in relation to agricultural work were considered. Concerning pesticides, the main findings among agricultural workers were that acute symptoms shortly after pesticide use were common, but there was no evidence of a syndrome specific to sheep dip use. Long-term symptoms, of the type that have been associated with OP use, were common in both users of sheep dip and in non-users. There was a strong association between somatising tendency and acute or longer-term symptoms, suggesting that psychosomatic factors could have an impact on symptom reporting. Among users of sheep dip, amount of use was associated with short-term and longer-term symptoms.

Accidental injury was common among agricultural workers but types and circumstances of injury were similar to those in non-agricultural occupations. Estimated accident rates from this study were considerably higher than rates for accidents reported under RIDDOR, particularly among self-employed agricultural workers. Some kinds of accident were particularly underreported, especially lifting and handling injuries in the self-employed.

Regarding other health problems, some were found to be more common among agricultural workers than in other occupations, particularly hip OA and Raynaud's phenomenon. However, despite recognised risk factors in agricultural work, hearing difficulty, hernia and anxiety and depression were similar in prevalence to that in non-agricultural workers, and hay fever and skin cancer were reported less in agricultural workers.

Men were less likely to have left an agricultural job because of ill health than other occupations. Available data supports the view that socioeconomic factors play a major role in this difference.

Table 9.1 provides a summary of the main study results and their significance.

Table 9.1 (i) Summary of main results relating to pesticides, accidental injury and health related job loss, and their significance

Results for male agricultural workers	Significance of findings
1. Symptoms associated with pesticide use	
a) Symptoms after pesticide use were common, particularly after sheep dip use.	a) A new finding. Further work is needed to determine the significance of self-reported symptoms.
b) There was no evidence of 'dippers flu'	b) Does not support anecdotal reports. Suggests the condition does not exist (though individual symptoms might occur)
c) Longer term neuropsychiatric symptoms did cluster in sheep dip users, but also in non-users and users of other pesticides	c) Casts doubt on the existence of COPIND and of a syndrome caused by specific toxicity
d) For multiple acute symptoms and longer term symptoms there was a strong association with somatising tendency.	d) A new finding. Further work is needed to determine its significance.
e) Both acute and longer term symptom reporting were associated with higher lifetime use of sheep dip in days and use of concentrate.	e) Consistent with other data. This study suggests that other factors besides toxicity are important. Further work needs to consider genetic and environmental factors including exposure, personal traits, publicity and the likelihood of co-incidental symptoms, particularly in high users.
2. Accidental Injury	
a) The frequency of injury was 15 per 1000 person years. Lifting and handling injuries and falls from a height were the most frequent circumstances cited.	a) Consistent with another survey though there are few comparable studies.
b) The groups at highest risk of accidental injury were new workers and those undertaking forestry work	b) Consistent with evidence from other countries. Identifies high risk groups in England and Wales on whom to target accident prevention activities.
c) Agricultural injuries are seriously under-reported especially those occurring in the self-employed.	c) Supports and adds to existing knowledge
3. Health related job loss	
a) Men were less likely to leave an agricultural job for health reasons than other jobs.	a) New finding. Little work in this area. Suggests that more can be done to reduce health related job loss in other occupations.
b) Musculoskeletal reasons were a dominant cause of job loss in agricultural workers (though the risk was lower than for other jobs)	b) Consistent with statistics from other countries. Provides data not obtainable from routine statistics in Great Britain.

Table 9.1 (ii) Summary of other main results and their significance

Results for male agricultural workers	Significance of findings
4. Other results	
a) The prevalence of depression was similar to that in non agricultural workers	a) Adds to existing evidence which remains inconsistent.
b) Hip osteoarthritis and hip replacement were associated with agricultural work as was lifting or moving heavy weights	b) Consistent with existing research that has considered these outcomes in detail.
c) Current shoulder and back pain were associated with agricultural work, but knee OA was not.	c) Supports and adds to existing knowledge
d) No association between seeking medical attention for hernia and agricultural work was found	d) Consistent with statistics from other countries. Suggests that earlier findings of increased PMR in English and Welsh farmers may have been spurious, possibly because of small numbers.
e) Raynaud's phenomenon was associated with forestry work and use of vibratory tools	e) Supports established knowledge. Highlights that agricultural workers who do some forestry are at risk. This group may benefit from targeted prevention advice.
f) Agricultural workers were at an increased risk of chronic bronchitis	f) Supports other evidence
g) The risk of hay fever was low compared to non-agricultural workers and early farm exposure appeared to have a protective effect in adult workers.	g) Consistent with evidence from other countries and adds to existing knowledge, particularly with respect to possible extension of early protective effect into adulthood. Impact of self–selection out of agriculture needs further investigation.
h) Agricultural work was associated with a low relative risk of skin cancer. (The study was not designed to investigate this in any detail)	h) A search for other evidence has highlighted a gap in existing knowledge and further research into the epidemiology of 'skin cancer other than melanoma' is required.

CHAPTER 10: RECOMMENDATIONS FOR FURTHER RESEARCH

The previous chapter summarises main findings from this study. Based on the findings, several further research questions have emerged. This chapter includes a summary of possible further work.

10.1 Acute and long term symptoms following use of pesticides and sheep dip

Three main questions that might usefully be addressed are listed below with subsidiary questions:-

- Do short term symptoms, of the type reported in this study, matter?
    - What proportion of symptoms are long lasting or recurrent and compromise work?
    - In those who continue to use specific pesticides after experiencing symptoms, do symptoms recur? Which symptoms, how often and how seriously?
- What is it about multiple symptom reporters that increased their susceptibility?
    - Are men who take action e.g. stop using pesticides because of symptoms, different from those who do not (for example in psychological profile and mental health factors).
    - Is prior somatising tendency a useful predictor of reporting symptoms following pesticide use?
- What factors influence the effect of cumulative exposure on long-term symptoms? (Further research to identify susceptible subgroups should take account of genetic and environmental factors including exposure to pesticide and publicity and personal characteristics.)

The study demonstrated that among agricultural workers acute symptoms shortly after pesticide use were common, especially among sheep dip users, but the pattern of symptoms reported was similar for different pesticide types and there was no evidence of a syndrome specific to sheep dip use, so the significance of reported symptoms is unclear. This question could be addressed through a follow up questionnaire to men who experienced symptoms and had agreed to be contacted again. The follow up questionnaire could explore the number and proportion of symptoms that were long lasting or recurrent and compromised work, and in those who continued to use specific pesticides after experiencing symptoms, whether symptoms recurred.

Current (longer-term) symptoms, of the type that have been associated with OP use, were common in both users of sheep dip and in non-users. In sheep dip users, the risk of current symptoms was associated with previous reporting of at least four symptoms shortly after sheep dip use. One factor that appeared to be associated with susceptibility to acute or longer-term symptoms was somatising tendency. The association was particularly strong in multiple symptom reporters, suggesting that psychosomatic factors could have an impact on symptom reporting. However further work is required to determine if somatising tendency precedes exposure related symptoms and whether it is a useful tool for identifying a susceptible subgroup.

Among users of sheep dip, amount of use was associated with ever experiencing short-term symptoms and with current neuropsychiatric symptoms. The risk of acute symptoms was also high in new users. It is not clear to what degree actual toxicity, knowledge of possible adverse effects, coincidental symptoms or other factors influence these associations. This could be explored further through semi-structured interviews.

10.2 Accidental Injury

Further research should focus on

- what level of supervision, safety advice and support new workers receive
- risk factors and current safety practices in British workers undertaking forestry

The main area on which further research should focus is reducing accidents in groups at highest risk. Within agriculture, those identified to be at highest risk in this study were the least experienced and forestry workers.

Important causes of accidental injury are recognised and preventive measures are in place in the form of advice, with or without legislative backing. However it is clear that adequate safety precautions are often not taken.

In order to guide where to focus efforts on promoting safety precautions, it would be useful to have more information on potentially preventable accidents occurring whilst doing forestry work, (i.e. those that may not have occurred if appropriate safety measures had been used). Also among new workers in different types of agricultural jobs, it would be helpful to determine what safety advice, training and supervision they currently receive.

10.3 Other health problems

Further work should be on

- The effectiveness of interventions to reduce heavy lifting on the prevalence of back, shoulder and hip problems in farmers.

- The population attributable risk for work related skin cancer

Other health problems were not investigated in sufficient depth to identify new questions, but monitoring the effect of safety interventions would be worthwhile.

An area where further research would be useful is in relation to occupational risk factors for skin cancer, particularly skin cancer other than melanoma. A number of occupational causes are known including sunlight and mineral oils, but there is uncertainty about the attributable burden of disease. A large case-control study could provide information on risk factors.

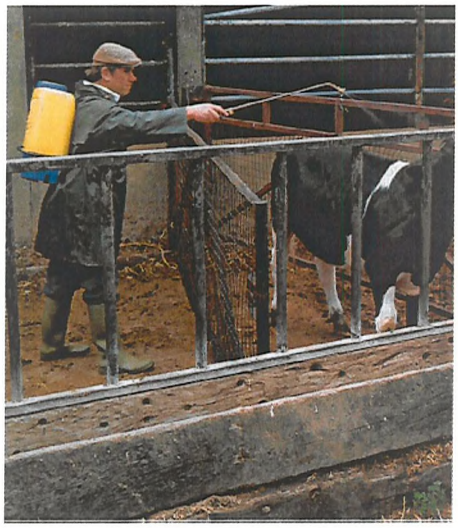
Despite recognised risk factors in agricultural work, skin cancer was reported less frequently by agricultural workers, than by other occupations.

10.4 Health related job loss

Work should

- Identify factors that influence long-term job loss

Further research in this area should focus on men of working age who fail to find another job within a few years. It would be helpful to have a better understanding of the relative importance of factors that contribute to long-term job less, for example types of health problem contributing to initial job loss, age, type of job left and other socio-economic factors.



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APPENDIX 1i

Information letter to General Practitioners From study team
(Devon, Shropshire, Lincolnshire)

MRC
Medical Research Council

MRC Environmental Epidemiology Unit
(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:
Our Reference: CLS/SMC

June 2002

Dear Dr (name)

HEALTH AND WORK IN RURAL POPULATIONS

We are carrying out a survey on work and health in rural populations, in which we plan to send a questionnaire to 30,000 men aged 25-69 years, who are resident in post-code areas where a high proportion of men are employed in agriculture. Some of the men we plan to mail will be patients registered with your practice.

A copy of the patient information letter and questionnaire is enclosed for your information. The study has received ethical approval from the South-West MREC and relevant LRECs have been informed.

The (name of agency) have selected names and addresses of patients from their data- base, and will be mailing men on our behalf. If you have any men aged 25-69 on your list to whom you feel it would be particularly inappropriate to send this questionnaire e.g. because of severe illness or bereavement, please could you inform (name) at the (name of agency, Tel number)

If you have any other queries about the study please contact Dr Solomon at the above address or telephone number or e-mail cls@mrc.soton.ac.uk

Yours sincerely,

David Coggon MA PhD DM FRCP FFOM FMedSci
Professor of Occupational and
Environmental Medicine

Christine Solomon MA MSc MRCGP FPHM
Consultant Research Fellow

Information letter to General Practitioners from study team
(Powys)

MRC
Medical Research Council

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July 2002

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HEALTH AND WORK IN RURAL POPULATIONS

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A copy of the patient information letter and questionnaire is enclosed for your information. The study has received ethical approval from the South-West MREC and relevant LRECs have been informed.

The Health Authority have selected names and addresses of patients from their data- base, and will be mailing men on our behalf. We are sending this letter via Dyfed Powys Health Authority so that they may enclose a list of men who have been selected as potential subjects. If you feel that it would be particularly inappropriate to send this questionnaire to any of these men e.g. because of severe illness or bereavement, please could you inform (name) at Dyfed Powys Health Authority, Tel (number)

If you have any other queries about the study please contact Dr Solomon at the above address or telephone number or e-mail cls@mrc.soton.ac.uk

Yours sincerely,

David Coggon MA PhD DM FRCP FFOM FMedSci
Professor of Occupational and
Environmental Medicine

Christine Solomon MA MSc MRCGP FPHM
Consultant Research Fellow

Patient letter and information sheet
(Devon, Shropshire, Lincolnshire)

MRC
Medical Research Council

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(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:
Our Reference: CLS/SMC

September 2002

Dear Sir

Health and Work in Rural communities

I am writing to ask whether you would help us with some research that we are doing into health and work in rural communities. We are looking at ways in which people's work might influence their health, and also at the effect of illness on people's ability to work.

(Name of agency), who maintain a list of patients registered with GPs in your area, have kindly agreed to forward this letter to you on our behalf.

Please could you help us by answering the enclosed questionnaire and posting it back in the pre-paid envelope provided? The questionnaire should take 20 – 30 minutes to complete.

Any information you give us will be treated in strict confidence, and will not be seen by anyone outside the small study team. It will be used only for this medical research, which we hope will lead eventually to better control of hazards in the workplace. No information will be published that could lead to the identification of individuals.

Participation in the study is voluntary and if you choose not to respond, we can assure you that the care which you receive through the NHS will not be affected in any way. However, we very much hope that you will be willing to help us, even if some parts of the questionnaire do not apply to you. In this way we can get the most reliable picture of the patterns of work and health in rural communities, and the findings will have more meaning. If you have difficulty understanding or answering any of the questions, please ask a friend or relative to help you.

If you have any further queries about the study please call me at the MRC on the above telephone number, or alternatively leave your name, number and a convenient time to call and I will ring you back. At the end of the study, a short summary of the findings will be sent to your general practice. The full results of the study will be published as reports in scientific journals and drawn to the attention of those responsible for relevant areas of policy (eg the Health and Safety Executive). In addition, some of the findings will form part of a PhD thesis.

Thank you for your time and help.

Yours sincerely,

Dr. Christine Solomon
Consultant Research Fellow

Patient letter and information sheet
(Powys – Welsh translation also sent)

MRC
Medical Research Council

MRC Environmental Epidemiology Unit
(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:
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September 2002

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If you would like the questionnaire translated into Welsh please contact (name) at Dyfed Powys Health Authority, Tel (number). If you have any further queries about the study please call me at the MRC on the above telephone number, or alternatively leave your name, number and a convenient time to call and I will ring you back. At the end of the study, a short summary of the findings will be sent to your general practice. The full results of the study will be published as reports in scientific journals and drawn to the attention of those responsible for relevant areas of policy (eg the Health and Safety Executive). In addition, some of the findings will form part of a PhD thesis.

Thank you for your time and help.

Yours sincerely,

Dr. Christine Solomon
Consultant Research Fellow

APPENDIX 2III

Patient letter and information sheet
(Powys – Welsh version)

MRC
Medical Research Council

MRC Environmental Epidemiology Unit
(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:
Our Reference: CLS/SMC

Medi 2002

Annwyl syr,

Iechyd a gwaith mewn cymunedau gwledig

Ysgrifennaf atoch i ofyn os byddwch yn fodlon ein cynorthwyo efo gwaith ymchwil yr ydym yn ei wneud ar iechyd a gwaith mewn cymunedau gwledig. Rydym yn edrych ar y ffyrdd y gall gwaith pobl effeithio ar eu hiechyd, a hefyd ar effaith salwch ar allu pobl i weithio.

Mae Awdurdod Iechyd Dyfed Powys, sydd yn cadw rhestr o gleifion wedi'u cofrestru gyda meddygon teulu yn eich ardal, wedi cytuno'n garedig i yrru'r llythyr hwn ymlaen atoch ar ein rhan.

Os gwelwch yn dda, allech chi ein helpu ni trwy gwblhau'r holiadur amgaeëdig a'i ddychwelyd yn yr amlen daledig a ddarparwyd ar eich cyfer? Dylai cwblhau'r holiadur gymryd rhyw 20 – 30 munud.

Caiff unrhyw wybodaeth y byddwch yn ei rhoi i ni ei thrin yn gwbl gyfrinachol; ni chaiff ei gweld gan unrhyw un o'r tu allan i'r tîm astudio bach. Caiff ei defnyddio ar gyfer yr ymchwil feddygol hon yn unig, ymchwil yr ydym yn gobeithio y bydd yn arwain at reolaeth well ar beryglon yn y gweithle. Ni chaiff gwybodaeth ei chyhoeddi a allai arwain at adnabod unigolion.

Mae cymryd rhan yn yr ymchwil yn wirfoddol, ac os byddwch yn dewis peidio ag ymateb, ni fydd hynny'n effeithio mewn unrhyw fodd ar y gofal yr ydych yn ei dderbyn gan y GIG. Fodd bynnag, rydym yn gobeithio'n fawr y byddwch yn fodlon ein helpu, hyd yn oed os nad yw rhannau o'r holiadur yn berthnasol ichi. Fel hyn y gallwn ni gael yr olwg mwyaf dibynadwy o batrymau gwaith ac iechyd mewn cymunedau gwledig, ac felly bydd mwy o ystyr i'r darganfyddiadau. Os oes gennych anawsterau gyda deall neu ateb unrhyw o'r cwestiynau, os gwelwch yn dda a wnewch chi ofyn i ffrind neu berthynas i'ch cynorthwyo.

Os hoffech gopi o'r holiadur wedi'i gyfieithu i'r Gymraeg, a wnewch chi gysylltu â [name], Awdurdod Iechyd Dyfed Powys, rhif ffôn [number]. Os oes gennych unrhyw gwestiynau pellach ynglŷn â'r astudiaeth, a wnewch chi fy ffonio yn yr MRC ar y rhif uchod, neu gallwch adael eich enw, rhif ffôn a manylion am amser cyfleus, ac fe'ch ffoniaf yn ôl. Ar ddiwedd yr astudiaeth, caiff crynodeb o'r darganfyddiadau ei anfon at eich meddygfa deulu. Caiff canlyniadau llawn yr astudiaeth eu cyhoeddi fel adroddiadau mewn cylchgronau gwyddonol a'u dwyn i sylw y rhai sydd yn gyfrifol am agweddau polisi perthnasol (e.e. yr Health & Safety Executive). Hefyd caiff rhan o'r darganfyddiadau eu cynnwys mewn thesis doethuriaeth.

Diolch am eich amser a'ch cymorth.

Yr eiddoch yn gywir,

Dr. Christine Solomon
Cymrawd Ymchwil Ymgynghorol

Letter from agency to patient (on headed paper of the relevant agency)
Welsh translation included to subjects in Powys

September 2002

Dear Patient,

The (name of agency) has agreed to help a team of doctors from Southampton General Hospital who are carrying out a survey of health and work in rural communities. They have asked us to forward the enclosed letter to you so that you can decide whether to take part by answering their questionnaire.

We have chosen you (and others) from a list that we hold of all patients registered with general practitioners in this area, and not because of any health problems from which you may or may not have suffered. Your name and address have not been given to the research team.

We believe this is a worthwhile project and hope that you will be able to help. However, participation is entirely voluntary, and whether or not you take part will not in any way affect the care that you receive from the National Health Service.

Yours sincerely,

Name

APPENDIX 4 **Reminder letter from agency to patient (on headed paper of the relevant agency)**
Welsh translation included to subjects in Powys

MRC
Medical Research Council

MRC Environmental Epidemiology Unit

(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:
Our Reference: CLS/SMC

October 2002

Dear Sir

Health and Work in Rural Communities

In case our earlier letter went astray, I am writing again to ask whether you would help us with some research that we are doing into health and work in rural communities. We are looking at ways in which people's work might influence their health, and also at the effect of illness on people's ability to work. ***If you have already replied, please ignore this reminder.***

(name of agency), who maintain a list of GPs registered in your area, have kindly agreed to forward this letter to you on our behalf. Please could you help us by answering the enclosed questionnaire and posting it back in the pre-paid envelope provided? **WE WOULD VALUE YOUR REPLY EVEN IF YOU HAVE NOT LIVED IN THE AREA FOR LONG, OR YOU HAVE RETIRED.** The questionnaire should take 20 – 30 minutes to complete.

Any information you give us will be treated in strict confidence, and will not be seen by anyone outside the small study team. It will be used only for this medical research, which we hope will lead eventually to better control of hazards in the workplace. No information will be published that could lead to the identification of individuals.

Participation in the study is voluntary and if you choose not to respond, we can assure you that the care which you receive through the NHS will not be affected in any way. However, we very much hope that you will be willing to help us, even if some parts of the questionnaire do not apply to you. In this way we can get the most reliable picture of the patterns of work and health in rural communities, and the findings will have more meaning. If you have difficulty understanding or answering any of the questions, please ask a friend or relative to help you.

If you have any further queries about the study please call me at the MRC on the above telephone number, or alternatively leave your name, number and a convenient time to call and I will ring you back. At the end of the study, a short summary of the findings will be sent to your general practice. The full results of the study will be published as reports in scientific journals and drawn to the attention of those responsible for relevant areas of policy (eg the Health and Safety Executive). In addition, some of the findings will form part of a PhD thesis.

Thank you for your time and help.

Yours sincerely,

Dr. Christine Solomon
Consultant Research Fellow

Health and Work in Rural Communities

Questionnaire

MRC

Medical Research Council

HEALTH AND WORK IN RURAL COMMUNITIES

SECTION ONE: ABOUT YOURSELF

1) What is your date of birth? date month 19 year

2) What is your height? ft ins

and your weight? stones lbs

3) What is your marital status? married Separated or divorced widowed single

4) Have you ever smoked regularly *(i.e. at least once per day for a month or longer)*? Yes No

If yes **do you still smoke regularly?** **Yes** **No**

5) How much of the following do you drink per week, on average?

Beer, cider, lager pints

Wine, sherry, vermouth glasses

Spirits, liqueurs measures

SECTION TWO: ABOUT YOUR WORK

6) We would like to know a little about the jobs that you have done.
Please fill in the table below **for each job that you have done for a year or more** since you left school. Include military service where relevant, and also any spells of unemployment lasting a year or more.
List each job in turn, placing the earliest at the top of the list.

Age at which you started the job	Age at which you finished the job	**Precise Occupation** Describe exactly what job you did e.g. garage mechanic, bank clerk, machinist in a carpet factory	**Please tick if you were self-employed**	**Please tick if an average working day involved** Shift work	Lifting or moving weights of 56lb (25 kg) or more by hand	Use of powered tools or machines that made your hands vibrate	Kneeling or squatting for more than one hour in total	Driving a lorry, tractor, digger or off road vehicle	Working for more than one hour in total with one or both hands above shoulder height	Using a mobile phone	Use of a computer keyboard or typewriter for more than 4 hours in total	So much noise that conversation would be impossible without shouting

If you have had more than 8 jobs, please give details on a separate sheet of paper

7. Have you ever left, or given up a job (including jobs held for less than a year) because of a health problem? No ☐ Yes ☐

If yes please give details below

Occupation	Age left job	Nature of health problem

8) Please tell us whether you have ever worked, **in a paid job,** with any of the chemicals listed in the following table. ***No*** ☐ ***Yes*** ☐

If yes, please fill in each line of the table.

Chemical type	(please tick)		Age first worked with this type of chemical	Age last worked with this type of chemical	How many days in total have you worked with this type of chemical over your working life? (Please tick)			Did the work involve mixing or handling a concentrate, before it was diluted? (please tick)		
	No	Yes			Less than 10 days	10 - 49 days	50 or more days	No	Yes	Not applicable
Herbicides (weed killers)										
Fungicides										
Insecticides										
Chemical Fertilizers										
Sheep Dip										
Wood Preservatives										

9) How long altogether have you worked in noisy places where conversation would be impossible without shouting ?

Never ☐ Less than 12 months ☐ 1-5 years ☐ 6-10 years ☐ More than 10 years ☐

10) Have you ever worked in farming, forestry or market gardening? (Please include any such work, whether or not it was for as long as a year) No ☐ Yes ☐

***If yes** please fill in the table below about the jobs you have done in farming, forestry or market gardening. List each job in turn, placing the earliest at the top of the list.*

Age at which you started the job	Age at which you finished the job	**Please tick if you were self employed**	**Type of farming or agricultural work – Please tick if you did this sort of work in the job**									
			Beef	Dairy	Sheep	Pigs	Poultry	Cereals	Vegetables	Fruit	Forestry	other

SECTION THREE: OTHER ASPECTS OF YOUR LIFE

11) Did you live on a farm at any time before the age of 16? ***No*** ☐ ***Yes*** ☐

If yes
How old were you when you first lived on a farm? ☐☐ years

And did that farm have any of the following? (please tick all that apply)

cattle ☐ sheep ☐ pigs ☐ poultry ☐

12) Do you use a mobile phone? ***No*** ☐ ***Yes*** ☐

If yes
Is the mobile phone you use most often: ***Hand-held?*** ☐ ***Hands-free?*** ☐ Both a similar amount? ☐

13) During the past month, for how long have you used a mobile phone (excluding text messages)?

0 minutes ☐ 1-19 minutes ☐ 20 – 59 minutes ☐ 1- 4.9 hours ☐ 5 or more hours ☐

14) Have you ever experienced any of the following while using or immediately after using a mobile phone?

	no	yes
Ear warming		
Giddiness		
Headache		
Blurred vision		
Deafness		

15) Over your life-time, on how many occasions have you fired a shot gun, pistol or rifle (not air rifle)?

never ☐ 1-100 times ☐ More than 100 times ☐

SECTION FOUR : ABOUT YOUR HEALTH

16) Do you have any long-term illness, health problem or handicap which limits your daily activities or the work you can do? (Include any problems that you consider to be

due to your age). ***No*** ☐ ***Yes*** ☐

Some questions about hearing

17) Do you use a hearing aid? ***No*** ☐ ***Yes*** ☐

18) How well can you hear a person who is talking to you when he/she is sitting on your RIGHT SIDE in a quiet room? (please tick one box)

Cannot hear him at all ☐ With great difficulty ☐ With moderate difficulty ☐

With slight difficulty ☐ With no difficulty ☐

19) How well can you hear a person who is talking to you when he/she is sitting on your LEFT SIDE in a quiet room? (please tick one box)

Cannot hear him at all ☐ With great difficulty ☐ With moderate difficulty ☐

With slight difficulty ☐ With no difficulty ☐

A question about heart problems

20) Have you ever been told by a doctor that you have angina or a heart attack? ***No*** ☐ ***Yes*** ☐

Some questions about joint problems

21) Have you had pain in or around your shoulder <u>on most days in the past month?</u>

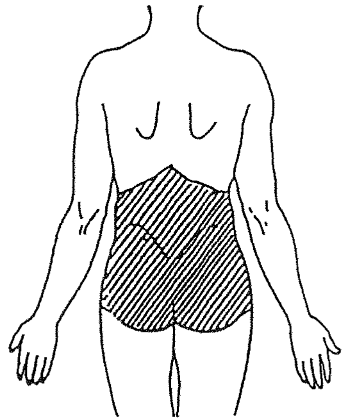
No ☐ Right shoulder only ☐ Left shoulder only ☐ Both shoulders ☐

If yes, <u>during the past month</u> did the pain make it difficult or impossible to comb or brush your hair?

No difficulty ☐ Difficult but not impossible ☐ Impossible ☐

22) <u>During the past month</u> have you had pain in the area shown in the diagram which lasted for more than a day? (Do not include pain occurring only during the course of a feverish illness such as 'flu'.)

No ☐ Yes ☐



If yes, <u>during the past month</u> did the pain spread down your leg to below your knee?

No ☐ Yes ☐

And at its worst, <u>during the past month</u> did the pain make it difficult or impossible to put on socks?

No difficulty ☐ Difficult but not impossible ☐ Impossible ☐

Some questions about chest problems

23) Have you had wheezing or whistling in your chest at any time <u>over the past year?</u> No ☐ Yes ☐

If yes <u>in the past year</u>, on how many days have you had wheezing? *(please tick one box)*
1 – 5 days ☐ 6 – 19 days ☐ 20 days or more ☐

24) Over <u>the past year</u> have you ever found that you became breathless when walking, at your own pace, on the flat? No ☐ Yes ☐

25) Do you have a cough on most days?
In the summer No ☐ Yes ☐
In the winter No ☐ Yes ☐

26) Do you bring up phlegm from your <u>chest</u> (not the back of your nose) most mornings for three months or longer per year ? No ☐ Yes ☐

If yes, for how long have you had phlegm like this?
Less than 1 year ☐ 1 to 3 years ☐ More than 3 years ☐

27) If you run, or climb stairs fast do you ever:
cough? No ☐ Yes ☐
wheeze? No ☐ Yes ☐
get tight in the chest? No ☐ Yes ☐

28) Is your sleep ever broken by:
wheeze ? No ☐ Yes ☐
difficulty with breathing? No ☐ Yes ☐

29) Do you ever wake up in the morning (or from your sleep if you are a shift worker) with:
wheeze? No ☐ Yes ☐
difficulty with breathing? No ☐ Yes ☐

30) Do you ever wheeze:
if you are in a smoky room? No ☐ Yes ☐
if you are in a very dusty place? No ☐ Yes ☐

31) Have you ever been told by a doctor that you have hay fever? No ☐ Yes ☐

Some questions about how you feel and other symptoms.

32) During the **past month** have you had any of the following? For each question, please give the one answer that comes closest to how much you have suffered during the past month. *(please tick one box on each line)*

	All of the time	***Most of the time***	***A good bit of the time***	***Some of the time***	***A little of the time***	***None of the time***
Headache						
Difficulty concentrating						
Difficulty remembering things						
Dizziness or fainting						
Difficulty with your handwriting						
Muscle aches and pains						
Numbness or tingling in your fingers or toes that lasted longer than 3 minutes						
Loss of appetite						
Difficulty speaking (e.g. in finding the right words or getting words out)						
Sensitivity to certain smells (e.g. perfumes)						
Increased sensitivity to the effects of alcohol						
Tiredness and lack of energy						

33) The following questions concern attitude toward illness. Please tick **yes** or **no** in the box that seems most suitable to you:

	No	Yes
a) Do you often worry about the possibility that you have got a serious illness?		
b) Are you bothered by many pains and aches?		
c) Do you find that you are often aware of various things happening to your body?		
d) Do you worry a lot about your health?		
e) Do you often have the symptoms of a very serious illness?		
f) If a disease is brought to your attention (through the radio, television, newspapers or someone you know), do you worry about getting it yourself?		
g) If you feel ill and someone tells you that you are becoming better, do you become annoyed?		
h) Do you feel that you are bothered by many different symptoms?		
i) Is it easy for you to forget about yourself and, think about all sorts of other things?		
j) Is it hard for you to believe the doctor when he tells you that there is nothing for you to worry about?		
k) Do you get the feeling that people are not taking your illness seriously enough?		
l) Do you think that you worry about your health more than most people?		
m) Do you think that there is something seriously wrong with your body?		
n) Are you afraid of illness?		

The questions in this section are about how you feel.

34) For each question tick the **one** item which comes closest to how you have been feeling **in the past week**. (Don't take too long over your replies; your immediate reaction to each item will probably be more accurate than a long thought out response).

(a)	I feel tense or 'wound up':	**Most of the time**	☐	**A lot of the time**	☐	*From time to time, occasionally*	☐	**Not at all**	☐
(b)	I still enjoy the things I used to enjoy:	*Definitely as much*	☐	*Not quite so much*	☐	*Only a little*	☐	*Hardly at all*	☐
(c)	I get a sort of frightened feeling as if something awful is about to happen:	*Very definitely and quite badly*	☐	*Yes, but not too badly*	☐	*A little, but it doesn't worry me*	☐	*Not at all*	☐
(d)	I can laugh and see the funny side of things:	*As much as I always could*	☐	*Not quite so much now*	☐	*Definitely not so much now*	☐	*Not at all*	☐
(e)	Worrying thoughts go through my mind:	*A great deal of the time*	☐	*A lot of the time*	☐	*From time to time but not too often*	☐	*Only occasionally*	☐
(f)	I feel cheerful:	*Not at all*	☐	*Not often*	☐	*Sometimes*	☐	*Most of the time*	☐
(g)	I can sit at ease and feel relaxed:	*Definitely*	☐	*Usually*	☐	*Not often*	☐	*Not at all*	☐
(h)	I feel as if I am slowed down:	*Nearly all the time*	☐	*Very often*	☐	*Sometimes*	☐	*Not at all*	☐
(i)	I get a sort of frightened feeling like 'butterflies' in the stomach:	*Not at all*	☐	*Occasionally*	☐	*Quite often*	☐	*Very often*	☐
(j)	I have lost interest in my appearance:	*Definitely*	☐	*I don't take so much care as I should*	☐	*I may not take quite as much care*	☐	*I take just as much care as ever*	☐
(k)	I feel restless as if I have to be on the move:	*Very much indeed*	☐	*Quite a lot*	☐	*Not very much*	☐	*Not at all*	☐
(l)	I look forward with enjoyment to things:	*As much as ever I did*	☐	*Rather less than I used to*	☐	*Definitely less than I used to*	☐	*Hardly at all*	☐
(m)	I get sudden feelings of panic:	*Very often indeed*	☐	*Quite often*	☐	*Not very often*	☐	*Not at all*	☐
(n)	I can enjoy a good book or radio or TV programme:	*Often*	☐	*Sometimes*	☐	*Not often*	☐	*Very seldom*	☐

35) Below is a list of problems that people sometimes have. Please read each one carefully and circle the number to the right that best describes **how much that problem has distressed or bothered you during the past 7 days including today.** *Please circle only one number for each problem.*

How much were you distressed by:	Not at all	A little	Moderately	Quite a bit	Extremely
a) Faintness or dizziness?	0	1	2	3	4
b) Pains in the heart or chest?	0	1	2	3	4
c) Your feelings being easily hurt?	0	1	2	3	4
d) Feeling that people are unfriendly or dislike you?	0	1	2	3	4
e) Feeling inferior to others?	0	1	2	3	4
f) Nausea or upset stomach?	0	1	2	3	4
g) Trouble getting your breath?	0	1	2	3	4
h) Hot or cold spells?	0	1	2	3	4
i) Numbness and tingling in parts of your body?	0	1	2	3	4
j) Feeling weak in parts of your body?	0	1	2	3	4
k) Feeling very self-conscious with others?	0	1	2	3	4

Some questions about other health problems

36) Have you ever had any episodes in which any or all of your fingers suddenly became cold and numb, and at the same time turned white or pale? No ☐ Yes ☐

If yes Have the attacks ever been brought on by cold conditions? No ☐ Yes ☐

During an attack have you ever noticed a clear 'edge' between the white or pale part of your finger and the normal colour of your hand? No ☐ Yes ☐

37) Have you ever suffered from any of the following **badly enough to see a GP, attend hospital or take time off work**? No ☐ Yes ☐

If yes then please fill in the table

	Saw GP			Attended hospital			Taken time off work		
	No	Yes	Age you first saw GP	No	Yes	Age you first attended hospital	No	Yes	Age you first took time off work
Shoulder pain									
Back pain									
Asthma									
Dermatitis									
Cancer of the skin or lip									
Stress or mental Illness									
Muscle weakness									
Tiredness or fatigue									
Arthritis of the hip									
Arthritis of the knee									
Arthritis of your hand that included swelling around your knuckles									
Hernia (i.e. rupture in your groin)									
Parkinson's Disease									
Change in personality e.g. a tendency to depression or irritability									
Difficulty speaking (e.g. in finding the right words or getting words out)									
Hearing difficulties									
Difficulty with your handwriting									
Thoughts about harming yourself or committing suicide									

38) Have you ever had any of the following operations?

If yes, please give your age when you first had the operation.

	No	Yes	Age first had operation
Hip replacement			
Knee replacement			
Knee cartilage surgery			
Hernia repair (i.e repair of rupture in your groin)			

39) Have you ever had an accident **at work** that was bad enough to take **three or more days off work**? No ☐ Yes ☐

If yes, please give the details in the table.

	Age	Occupation at the time	Type of injury (please tick the boxes that apply)									Circumstances of injury *e.g. fell off a ladder*
			Fracture	Head Injury	Cut needing stitches	Burn or scald	Amputation	Back Injury	Other sprain	Eye injury	Other	
1												
2												
3												
4												
5												

40) Have you ever noticed that you suffered from any of the following within **48 hours** of working with a pesticide or sheep dip? No ☐ Yes ☐

If yes, please fill in the table. (Even if you cannot remember the names of the chemical(s) you had been using, please fill in the rest of the table as best you can)

	No	Yes	Age first occurred	Name(s) of chemical (s)	Type of chemical (tick)				
					herbicide	fungicide	insecticide	Wood preservative	Sheep dip
Runny nose									
Headache									
Aching limbs									
Fever or chills									
Giddiness									
Restlessness or anxiety									
Inability to concentrate									
Difficulty breathing									
Diarrhoea									
Blurred vision									
Muscle weakness									
Numbness or tingling in your hands or feet that lasted longer than 3 minutes									

YOU HAVE FINISHED! THANK YOU FOR FILLING IN THIS QUESTIONNAIRE

It is possible that we might wish to contact you in the future to ask a few further questions. May we have your permission to write to you about this if needed? (please tick yes or no)

☐ Yes, I would be happy for you to write to me

☐ No , I do not wish you to write to me

Health and Work Questionnaire

MRC
Medical
Research Council

SECTION ONE: ABOUT YOURSELF

1) What is your date of birth?

				19			
date		month		year			

SECTION TWO: ABOUT YOUR WORK

2) We would like to know a little about the jobs that you have done.
Please fill in the table below **for each job that you have done for a year or more** since you left school. Include military service where relevant, and also any spells of unemployment lasting a year or more. List each job in turn, placing the earliest at the top of the list.

Age at which you started the job	Age at which you finished the job	**Precise Occupation** Describe exactly what job you did e.g. garage mechanic, bank clerk, machinist in a carpet factory	Please tick if you were self-employed

If you have had more than 5 jobs, please give details on a separate sheet of paper

3) Have you ever left, or given up a job (including jobs held for less than a year) because of a health problem?

Yes ☐ No ☐

If yes please give details below

Occupation	Age left job	Nature of health problem

4) Have you ever worked, **in a paid job** (employed or self- employed) with any of the following chemicals?

	No	Yes	Age first worked with this type of chemical
Insecticides			
Herbicides (weed killers)			

	No	Yes	Age first worked with this type of chemical
Sheep Dip			
Fungicides			

SECTION THREE : ABOUT YOUR HEALTH

5) During the **past month** have you had any of the following? For each question, please give the one answer that comes closest to how much you have suffered during the past month. *(please tick one box for each symptom)*

	All or most of the time	***Some or none of the time***
Headache		
Difficulty concentrating		

	All or most of the time	***Some or none of the time***
Difficulty remembering things		
Tiredness and lack of energy		

6) Have you ever suffered from any of the following **badly enough to see a GP, attend hospital or take time off work**?
If yes, please give your age when this first occurred.

	No	Yes	Age this first occurred
Dermatitis			
Stress or mental Illness			
Muscle weakness			
Tiredness or fatigue			
Parkinson's Disease			
Change in personality e.g. a tendency to depression or irritability			
Difficulty with your handwriting			

7) Have you ever had either of the following operations? **If yes**, please give your age when you first had the operatio

	No	Yes	Age first had operation
Hip replacement			
Hernia repair (i.e repair of rupture in your groin)			

8) Have you ever had an accident **at work** that was bad enough to take **three or more days off work**?
No ☐ Yes ☐

If yes, please give the details in the table

Age at time of accident	Occupation at the time	Circumstances of injury *e.g. fell off a ladder*

THANK YOU FOR FILLING IN THIS QUESTIONNAIRE

APPENDIX 7 LETTER TO ACCOMPANY SHORT QUESTIONNAIRE

MRC
Medical Research Council

MRC Environmental Epidemiology Unit
(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:

Our Reference: CLS/SMC

May 2003

Dear Sir

Health and Work in Rural Communities

Some months ago, I wrote asking for your help with some research that our department is doing on health and work in people who live in rural areas. We are interested in how people's work affects their health, and also in the effect of illness on people's ability to work in different jobs. The aim is to find ways of preventing illness and improving services for those who are ill.

Unfortunately, although many people have answered our questionnaire, the response has been lower than in similar studies that we have carried out previously. Some people may have been put off by the impersonal way in which they were approached (our letters are forwarded to you by your local health service, and to preserve your privacy, we are not told your name). Others may have felt that the questionnaire did not apply to them, or was too long. Whatever the reason, the low response makes it harder to draw useful conclusions from the research.

We are therefore making a special request to a small but representative sample of those who did not reply earlier, and you are one of the people chosen.

It would help us enormously if you could find time to answer the enclosed (much shorter questionnaire) and return it in the prepaid envelope provided.

Some further information about the study is given overleaf.

I do hope you will feel able to help.

Yours sincerely,

Dr. Christine Solomon
Consultant Research Fellow

Health and Work in Rural Communities

FURTHER INFORMATION

The National Public Health Service (formerly Dyfed Powys Health Authority), who maintain a list of patients registered with GPs in your area, have selected your from the list and kindly agreed to forward this letter to you on our behalf. Your name and address have not been given to the research team at the Medical Research Council (MRC) in Southampton.

Any information you give to us, at the MRC, will be treated in strict confidence, and will not be seen by anyone outside the small study team. No information will be published that could lead to the identification of individuals.

Participation in the study is voluntary and if you choose not to respond, we can assure you that the care which you receive through the NHS will not be affected in any way. However, we very much hope that you will be willing to help us.

If you are not able to complete the questionnaire, it would be helpful if you could inform us of the serial number so we can make sure you are not troubled again.

At the end of the study, a short summary of the findings will be sent to your general practice. The full results of the study will be published as reports in scientific journals and drawn to the attention of those responsible for relevant areas of policy (eg the Health and Safety Executive).

Dr Christine Solomon

MRC
Medical Research Council

MRC Environmental Epidemiology Unit
(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

Telephone: +44 (0) 23 8077 7624
Fax No: +44 (0) 23 8070 4021

Your Reference:

Our Reference: CLS/SMC

September 2003

Dear Patient,

Health and Work in Rural Communities

I am writing to ask whether you would help us with some research that we are doing into health and work in rural communities. We are looking at ways in which people's work might influence their health, and also at the effect of illness on people's ability to work.

Your general practitioner has kindly agreed to forward this letter to you on our behalf.

Please could you help us by answering the enclosed questionnaire and posting it back in the pre-paid envelope provided? The questionnaire should take 20 – 30 minutes to complete.

Any information you give us will be treated in strict confidence, and will not be seen by anyone outside the small study team. It will be used only for this medical research, which we hope will lead eventually to better control of hazards in the workplace. No information will be published that could lead to the identification of individuals.

Participation in the study is voluntary and if you choose not to respond, we can assure you that the care which you receive through the NHS will not be affected in any way. However, we very much hope that you will be willing to help us, even if some parts of the questionnaire do not apply to you. In this way we can get the most reliable picture of the patterns of work and health in rural communities, and the findings will have more meaning. If you have difficulty understanding or answering any of the questions, please ask a friend or relative to help you.

If you have any queries about the study please call me at the MRC on the above telephone number, or alternatively leave your name, number and a convenient time to call and I will ring you back. At the end of the study, a short summary of the findings will be sent to your general practice. The full results of the study will be published as reports in scientific journals and drawn to the attention of those responsible for relevant areas of policy (eg the Health and Safety Executive). In addition, some of the findings will form part of a PhD thesis.

Thank you for your time and help.

Yours sincerely,

Dr Christine Solomon
Consultant Research Fellow

MRC
Medical Research Council

MRC Environmental Epidemiology Unit
(University of Southampton)
Southampton General Hospital
Southampton
SO16 6YD

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Hydref 2003

Annwyl syr,

Iechyd a gwaith mewn cymunedau gwledig

Ysgrifennaf atoch i ofyn a fyddwch yn fodlon ein cynorthwyo gyda gwaith ymchwil yr ydym yn ei wneud ar iechyd a gwaith mewn cymunedau gwledig. Rydym yn edrych ar y ffyrdd y gall gwaith pobl effeithio ar eu hiechyd, a hefyd ar effaith salwch ar allu pobl i weithio.

Mae eich meddyg teulu wedi cytuno'n garedig i yrru'r llythyr hwn ymlaen atoch ar ein rhan. Os gwelwch yn dda, allech chi ein helpu ni trwy gwblhau'r holiadur amgaeëdig a'i ddychwelyd yn yr amlen daledig a ddarparwyd ar eich cyfer? Dylai cwblhau'r holiadur gymryd rhyw 20 – 30 munud.

Caiff unrhyw wybodaeth y byddwch yn ei rhoi i ni ei thrin yn gwbl gyfrinachol; ni chaiff ei gweld gan unrhyw un o'r tu allan i'r tîm astudio bach. Caiff ei defnyddio ar gyfer yr ymchwil feddygol hon yn unig, ymchwil yr ydym yn gobeithio y bydd yn arwain at reolaeth well ar beryglon yn y gweithle. Ni chaiff gwybodaeth ei chyhoeddi a allai arwain at adnabod unigolion.

Mae cymryd rhan yn yr ymchwil yn wirfoddol, ac os byddwch yn dewis peidio ag ymateb, ni fydd hynny'n effeithio mewn unrhyw fodd ar y gofal yr ydych yn ei dderbyn gan y GIG. Fodd bynnag, rydym yn gobeithio'n fawr y byddwch yn fodlon ein helpu, hyd yn oed os nad yw rhannau o'r holiadur yn berthnasol ichi. Fel hyn y gallwn ni gael yr olwg mwyaf dibynadwy o batrymau gwaith ac iechyd mewn cymunedau gwledig, ac felly bydd mwy o ystyr i'r darganfyddiadau. Os oes gennych anawsterau gyda deall neu ateb unrhyw o'r cwestiynau, os gwelwch yn dda a wnewch chi ofyn i ffrind neu berthynas i'ch cynorthwyo.

Os oes gennych unrhyw gwestiynau pellach ynglŷn â'r astudiaeth, a wnewch chi fy ffonio yn yr MRC ar y rhif uchod, neu gallwch adael eich enw, rhif ffôn a manylion am amser cyfleus, ac fe'ch ffoniaf yn ôl. Ar ddiwedd yr astudiaeth, caiff crynodeb o'r darganfyddiadau ei anfon at eich meddygfa deulu. Caiff canlyniadau llawn yr astudiaeth eu cyhoeddi fel adroddiadau mewn cylchgronau gwyddonol a'u dwyn i sylw y rhai sydd yn gyfrifol am agweddau polisi perthnasol (e.e. yr Health & Safety Executive). Hefyd caiff rhan o'r darganfyddiadau eu cynnwys mewn thesis doethuriaeth.

Diolch am eich amser a'ch cymorth.

Yr eiddoch yn gywir,

Dr. Christine Solomon
Cymrawd Ymchwil Ymgynghorol

Appendix 9i Patient letter from general practice

On GP paper signed for partners

Patient name and address

September 2003

Dear Name of patient,

Our practice has agreed to help a team of doctors from Southampton General Hospital who are carrying out a survey of health and work in rural communities. They have asked us to forward the enclosed letter to you so that you can decide whether to take part by answering their questionnaire.

We have chosen you (and others) from a list of all patients registered with the practice and not because of any health problems from which you may or may not have suffered. Your name has not been given to the research team.

We believe this is a worthwhile project and hope that you will be able to help. However, participation is entirely voluntary, and whether or not you take part will not in any way affect the care that you receive from the practice.

Yours sincerely,

APPENDIX 9II PATIENT LETTER FROM GENERAL PRACTICE WELSH VERSION

On GP paper signed for partners

Annwyl

Mae'r Awdurdod Iechyd hwn wedi cytuno i gynorthwyo tîm o feddygon o Southampton General Hospital, sydd yn arolygu iechyd a gwaith mewn cymunedau gwledig. Maent wedi gofyn inni yrru'r llythyr amgaeëdig ymlaen atoch er mwyn rhoi cyfle ichi benderfynu os ydych am gymryd rhan trwy ateb eu holiadur.

Rydym wedi eich dewis (ynghyd â phobl eraill) o restr yr ydym yn ei chadw o'r cleifion i gyd sydd wedi'u cofrestru gyda meddygon teulu yn yr ardal hon, a hynny nid oherwydd unrhyw broblemau iechyd yr ydych o bosibl yn dioddef ohonynt. Ni roddwyd eich enw na'ch cyfeiriad i'r tîm ymchwil.

Credwn fod y prosiect hwn yn un gwerth chweil ac rydym yn gobeithio y byddwch yn fodlon helpu. Fodd bynnag, mae cymryd rhan yn hollol wirfoddol, ac ni fydd eich dewis o'i wneud neu beidio yn effeithio o gwbl ar y gwasanaeth yr ydych yn ei dderbyn gan y Gwasanaeth Iechyd Gwladol.

Yr eiddoch yn gywir,

APPENDIX 10 SUMMARY OF DATA SOURCES ON OCCUPATIONAL HEALTH WITH PARTICULAR REFERENCE TO AGRICULTURE

Core data source	Note on source	Access to data	Comment
ONS Mortality statistics	Routinely collated from death certificates Occupation recorded should be most recent (main) occupation at time of death	Decennial supplement on occupational mortality.	Uses several data sources
		ONS	*Usually a cost to obtain information on occupation. Occupation not in most DH publications*
		Journal publications	*Analyses using ONS mortality data*
Cancer registration	Data on incidence and mortality	ONS Journal publications	Occupation not in published statistics. Can be requested (cost for analysis)
RIDDOR (reporting of injuries diseases and dangerous occurrences)	All deaths and specified injuries * should be reported to this scheme. Under-reporting of accident s particularly among farmers and self employed	HSE publications e.g. Health and Safety Statistics	
		Decennial supplement on occupational mortality	Uses several data sources
LFS (Labour force survey) **SWI** (Self-reported work related illness)	LFS is a continuous household survey, contains screening question for SWI. SWI collects further information and information from doctors. LFS has some questions on accidents at work	HSE publications and reports on web site	Large survey, but when analysed by occupation and illness, numbers are small. Useful for denominators (estimation of size of workforce)
DWP (Department of Work and Pensions)	Workmen's compensation, Sickness, incapacity and severe disablement benefits. Social security statistics. Less useful for self employed, small companies or contract workers who may not claim.	DWP publications	Statistics by category of health problem available from DWP on request (from 1996 when types of claim re-categorised)
		ONS	
		Summary data in HSE publications	
ODIN (Occupational disease intelligence network)	Occupational physicians and specialist report monthly on specified conditions associated with work** Co-ordinated at University of Manchester.	Results reported in journal publications	Only people referred for specialist advice seen and recorded. Farmers less likely to see occupational physicians than people working in large organisations.
HES (hospital episode statistics)	Hospital admissions. (Occupation incomplete)	ONS	Occupation not in published statistics
PIAP	Self report of pesticide related incidents	Annual reports	Under reporting likely. Usually acute symptoms
Agricultural Census	Annual June Census conducted by DEFRA. Data collected on land use, land tenure, crops, livestock and horticulture for all main holdings registered in England and Wales. (Scotland collected separately)	DEFRA	Raw statistics available
		ONS	Detailed reports including for Eng & Wales and Scotland.
		NFU	Summary reports use information from Census
Observational studies	Look at specified populations. Most non-UK	Journal publications	

* RIDDOR places a legal duty on employers, self-employed and those in control of premises to report deaths, major injuries, over-3-day injuries, injuries to members of public if they are taken to hospital, work related diseases and dangerous occurrences to the HSE or local authority.
**The scheme (ODIN) comprises surveillance for occupational respiratory, skin and communicable diseases, musculoskeletal conditions, psychiatric illness and hearing loss. Occupational Physicians report through Occupational Physicians Reporting Activity (OPRA). Individual reporting schemes for other specialists e.g. EPIDERM for dematologists, occupational surveillance scheme for audiology physicians (OSSA) and surveillance of work related respiratory disease (SWORD). Participating doctors send in monthly returns.