The Epidemiology of Regional and Widespread Pain Syndromes

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Submitted for the degree of Doctor of Medicine
at the University of Glasgow

The work was conducted at
The School of Epidemiology and Health Sciences,
The Victoria University of Manchester

August 2001

Abstract

Background: Pain is common in the general population. Approximately 50% of adults will report pain during the past month which has lasted at least 1 day. The most common sites for pain to occur are the lower back and upper limbs (particularly the shoulder), but chronic widespread body pain is also reported by around 10% of the general population. The majority of pain reported in a population would be considered to be of musculoskeletal origin. Even if one restricts attention to pain which results in some limitation of activities – the prevalence is still high. What is the aetiology of these common conditions?

Aims: This thesis, using published work explores the aetiology of regional and widespread body pain syndromes. They consider both the outcome and onset of symptoms in addition to some methodological issues arising from the work.

Methods: All the studies included are population-based. There were four studies conducted: The Stockport Shoulder Study, The North Cheshire Pain Study, The South Manchester Low Back Pain Study and The Altrincham Pain study. All were conducted on random samples of the adult population aged 18-65 years who were followed prospectively either to determine the onset or outcome of pain symptoms. These were then related to risk factor information, collected around the time of recruitment. The risk factor information included: a) individual (constitutional) factors such as age, gender, anthropometry, b) work-related mechanical (injury) factors c) psychological distress and d) psychosocial factors usually measured in the workplace and including measurements of demands, support available and autonomy. In addition, participants in two of the surveys were flagged at the Office for National Statistics and information on their vital status collected for up to ten years after participating in the original pain study. Their pain status on survey was then related to long-term mortality experience.

Results: The studies find that adverse psychological and psychosocial factors are strong predictors of onset and outcome of both regional and widespread pain syndromes. Mechanical factors are also important in the onset of regional pain syndromes, although the precise risk factor (load, posture, repetitive movements) varies between individual sites. There is little evidence for considering widespread body pain as a distinct entity from regional pain syndromes – instead it is more appropriate to think of it as one end of the pain spectrum. Persons reporting widespread pain in population surveys were also demonstrated to have increased mortality, principally a doubling of the risk of cancer death, over the subsequent decade. These remained true after removing those subjects who already had a diagnosis of cancer at the time of reporting widespread pain.

Conclusions: The papers included in the thesis have demonstrated that both mechanical (injury) factors, and psychological/psychosocial factors have an important influence on the onset of pain, and that both clinical and psychological/psychosocial factors are strongly related to outcome. The results provide some insight in to interventions that may be successful with respect to possible primary (in high risk occupational groups) and secondary prevention of some of these episodes. The finding that widespread pain is associated with an increased risk of cancer death in the long-term requires confirmation.

List of Contents

Page No.

Chapter 1 **Introduction**

Chapter 2 **The aetiology of regional and widespread pain syndromes**

Chapter 3 Predicting outcome of regional and widespread pain syndromes

Chapter 4 Methodological aspects of the epidemiological studies conducted

Chapter 5 The relationship between regional and widespread pain syndromes

Chapter 6 Summary

List of Tables and Figures

Tables

Figures

Acknowledgements

A great many people have contributed to making this thesis possible. Firstly I would like to thank my colleague Alan Silman, Professor of Rheumatic Disease Epidemiology at the Victoria University of Manchester with whom all the studies included in this thesis have been conducted. His enthusiasm and encouragement have made working in this field a real pleasure. I should also like to thank Peter Croft, Professor of Epidemiology at The University of Keele who was involved in the initial design of some of the studies included in this thesis, and who continued to retain an interest in some of them. Roger Sturrock, ARC Professor of Rheumatology at the University of Glasgow kindly agreed to be adviser for this thesis and gave helpful comments for its improvement.

The studies would not have been conducted to such a high standard without the dedication and hard work of my staff within the Pain Research Group. These have included Daniel Pope, John McBeth and Elaine Thomas, Isabelle Hunt (research assistants), Christina Pritchard, Joanna Schollum (research nurses), Dr. Stella Morris (psychiatrist), and Ann Papageorgiou (studies co-ordinator). My thanks go also to senior colleagues at The University of Manchester who helped with various aspects of designing, conducting and reporting the studies: Professor Malcolm Jayson, Dr. Sidney Benjamin both now retired but formerly of the Departments of Rheumatology and Psychiatry respectively and Professor Nicola M. Cherry, formerly of the Centre for Occupational Health at the School of Epidemiology and Health Sciences.

The studies included in the thesis were only possible with the help of both the doctors and patients at the participating practices. These included Drs. Marshall, Nield, Hardman and Martin at the practice used for the Stockport Shoulder Study, Drs. Shearer, Haworth, Pickering, Frank and Hyde at the Brooklands and Bowland Road Family Practices in South Manchester (South Manchester Low Back Pain Study), Drs. R.J. Woodhead, Z.M. Woodhead, Richardson and Burns from the general practice in Altrincham (Altrincham Pain Study) and to the doctors at the two practices participating in the North Ceshire Pain Study: Drs. Fuller, Day, Sandars, Smith and Hambleton (Handforth practice), Drs. M. Coope, John Coope, Jean Coope. G. Coope, Handler, Maxwell and Ramsden (Bollington Practice).

The studies were funded by The Arthritis and Rheumatism Council (now the Arthritis Research Campaign), Chesterfield, The Colt Foundation, Havant and The National Back Pain Association (now BackCare), Teddington.

I should also like to thank Lesley Jordan (my secretary) and Owen Stewart (computer manager) who helped to locate, retrieve and convert old computer files of manuscripts, and to Cathy Bryan (graphics designer) who help design many of the figures included in the original publications.

Without the encouragement of my wife, Tatiana, this thesis would never have got off the planning stage. She looked after our young children Matthew and Catherine on many weekends to allow me to make progress with the work. The fact that Matthew slept so well and that I had to stay up late most nights to feed Catherine, also speeded the thesis to its conclusion!

Last but not least I should like to record grateful thanks to my parents Margaret and John Macfarlane. Without their sacrifices for my early education I would certainly not have been able to achieve what I have, academically. Their encouragement and joy at sharing successes, has helped to make the hard work worthwhile.

Author's declaration

All work arising from large population-based epidemiological studies, is by its very nature, the product of an inter-disciplinary research team. This is true also of the work presented in this thesis. It has involved epidemiologists, rheumatologists, field workers, metrologists and statisticians.

The thesis incorporates 4 separate epidemiology studies. All the published papers have arisen from the research group of which the candidate was head (Pain Research Group, Arthritis Research Campaign Epidemiology Unit) or is currently head (The Unit of Chronic Disease Epidemiology) within the School of Epidemiology and Health Sciences at the Victoria University of Manchester. In three (The Stockport Shoulder Study, The North Cheshire Pain Study, The Altrincham Pain Study) the candidate had major involvement in the formulation of hypothesis, study design, conduct and analysis. In the remaining study (The South Manchester Low Back Pain Study) the author had major input into the analysis and its conduct. The mortality study, which involved subjects participating in two of the population studies, was conceived and designed by the candidate alone. Nine of the thirteen publications being submitted for this thesis have the author as the first (principal) or sole author. These were all written by the candidate. In two publications the candidate is the last (senior) author. With respect to these latter two papers the author coordinated analysis and wrote Paper A and had major involvement in the hypothesis, analysis, writing and revising Paper C. In the remaining two publications, the candidate had involvement in analysis for and writing/revising of Paper B (second publication) and the study design, conduct, analysis and writing/revising of Paper E. These latter two papers have been included because they are an important component of this area of research.

The sections of this thesis, additional to published manuscripts, are the sole work of the candidate.

Abbreviations

ACR	American College of Rheumatology
CI	Confidence Interval
CSAG	Clinical Standards Advisory Group
GHQ	General Health Questionnaire
GP	General Practitioner
IAS	Illness Attitude Scales
IQR	Inter-quartile Range
LBP	Low Back Pain
MRR	Mortality Rate Ratio
OR	Odds Ratio
RR	Relative Risk

CHAPTER 1 INTRODUCTION

1.1 Introduction

Pain is a common symptom which all of us feel at some time. It is most commonly the result of some minor injury and of short duration, often with little impact on the individual. In this sense, pain is an entirely normal experience. This is not the type pain in which epidemiologists are interested in studying. Rather we are interested in the chronic disabling pains which have an important public health impact. Such pain however is still relatively common: 55% of adults, randomly selected from the general population, will report pain during the previous month which has lasted at least one day, while 10% will report widespread body pain during the previous month which has lasted at least 3 months. Although certain serious medical conditions are associated with pain, in population terms the vast majority of pain would be considered to be of musculoskeletal origin.

Musculoskeletal pain is one of the four most common reasons for consultation to a general practitioner in both men and women at all ages above 25 years (Symmons and Bankhead, 1994). In the workplace, musculoskeletal pain is the most common cause of reported morbidity and days lost from work. In 1991-2 28% of all sickness and invalidity benefit "claim days" were for musculoskeletal diseases, having increased from 16% in 1978-9 (CSAG, 1994). For back pain alone, in 1998, the direct and indirect costs of care have been estimated at £ 1632 million and £ 10668 million respectively making it one of the most expensive conditions for which an economic analysis has been conducted (Maniadakis and Gray, 2000). Therefore musculoskeletal pain is an important problem for a substantial proportion of adults and more widely, for society.

Having established that symptoms are common, what are the causes? The work which is presented in this thesis was conducted over a decade between 1991-2000 and it is relevant, to understand the context in which the studies were designed, to consider our knowledge on the epidemiology of musculoskeletal pain in the 1980s. Regional pain syndromes (often labelled as "soft tissue rheumatism", "non-articular rheumatism" or "rheumatism unspecified") had been studied relatively infrequently considering their burden in the population. A few examples are given for illustrative purposes. In 1949-50 an adult population survey of approximately 3,000 persons conducted in Lancashire found that the prevalence of current "rheumatic complaints" was 16% in males and 21% in females (Kellgren et al, 1953). The majority of these were classified as specific disorders such as osteoarthritis (5% males, 8% females) and disc prolapse (4% males, 2% females) but 5% and 6% respectively were labelled as "Undetermined". The first National Health and Nutrition Examination Survey (NHANES) conducted in the United States (Cunningham and Kelsey, 1984) involving 6913 adults, indicated that 33% of US adults were currently affected by musculoskeletal signs and symptoms such as joint swelling, limitation of motion or pain on motion (however less than 1% were classified as having "non-articular rheumatism"). In the United Kingdom a population survey of 25168 households (of people aged over 16 years) in 1986 found that prevalence of "joint problems" (i.e. "pain, swelling, or stiffness in your joints, neck or back") overall was 23.9%. Prevalence increased from 4.9% at ages 16-24 years to 53.6% at ages over 85 years (Badley and Tennant, 1992).

There are problems however in comparing information from different studies and sources. Definitions of the conditions under study vary. Some have required clinical diagnoses, but the criteria used have differed. Others have relied on symptom reporting but have used different terms such as, in the case of the back, "bad back" "back ache" "back pain" or "back discomfort". Further, varying periods of reference have been used such as "currently", "past week", "past month", "past year" or "ever". Variations in the symptom and time-period used can result in dramatic difference in prevalence estimates. It was therefore difficult to conclude whether differences between studies represented real differences in the onset/persistence of symptoms or were artefactual. A further problem, in some instances was the type of classification used. As an example, in the 1980s conditions which included forearm pain as a prominent feature were commonly reported in some occupational settings. This was particularly true in Australia and the United States but these became common in several other industrialised countries later. The conditions became known by terms such as "Repetitive Strain Injury", "Cumulative Trauma Disorders" and "Overuse Syndrome". These terms imply both the nature of symptoms reported and presumed aetiology of such symptoms. Using such terms therefore it is impossible to determine the true aetiology. Instead the more appropriate approach is to use symptomatology (+/- clinical examination or tests) to classify subjects and then to determine the role of hypothesised risk factors on onset. This approach has been used recently in proposing classification criteria for (potentially) work-related upper limb disorders (Harrington et al, 1997; Sluiter et al, 2000).

By the 1980s, examination of risk factors for the onset of regional pain syndromes were confined to constitutional factors such as age, gender and anthropometry. Some studies had also examined the relationship with social class, and reported that those with low income and lower levels of secondary education were more likely to report musculoskeletal symptoms (Cunningham and Kelsey, 1984). A Swedish study, found that low educational attainment in adults was associated with the onset of shoulder pain and back pain (Bergenudd et al, 1988; Bergenudd and Nilsson, 1988). The relationship between musculoskeletal conditions and occupation had also been examined and certain occupations associated with increased rates. For example, forearm pain and epicondilytis were reported as most frequent in butchers, packers and clerks (compared with all other populations) in a study in Finland (Kivi, 1984) while garment workers (in comparison to health service workers) were found to report high levels of upper-limb pain symptoms in a United States study (Punnett et al, 1985). Both these latter factors (social class, occupational group) are simply markers of a possible set of work-place and leisure activities, and lifestyle in general. Further work was necessary to identify the precise exposures associated with these which could possibly confer increased risk. Around this time, major interest focussed on mechanical (injury) factors but the possibility of psychological factors playing a role had also been appreciated. In a review, Croft (1993) states "Various forms of soft tissue rheumatism have been considered to have an emotional or psychiatric basis……however the epidemiological evidence is scant" while Raspe

(1993), in relation to back pain concludes "The results of psychosocially-oriented studies show that it is promising to include (these) variables ..... but it is theoretically and statistically demanding to account for the complexity of the association and interactions".

With respect to chronic widespread body pain (referred to during the 1980s as fibrositis and later, fibromyalgia) what was known of these conditions? Firstly they were considered completely distinct from regional (or other non-articular) complaints considered above and in 1990 the American College of Rheumatology proposed classification criteria (Wolfe et al, 1990). It was considered that these symptoms primarily affected women, and were associated with insomnia and tenderness to palpation at multiple points throughout the body. It was also recognised that such symptoms were not new; reference to similar syndromes were evident at several points in historical medical literature although identified by multiple different diagnostic terms and with different views on aetiology. As Russell noted in a review in 1992 "a more consistent recognition of this disorder by all physicians will naturally increase the pressure on medical care systems to study the epidemiology ..". There was almost no information on its occurrence and "the initiating causes and mechanisms which perpetuate it are still elusive". Nevertheless the possible role of sleep disturbance and psychological factors had already been noted. Some of the papers included in this thesis address possible aetiology and methodological aspects of studying these symptoms. Russell (1992) also noted that although fibromyalgia had gained some acceptance as a diagnostic term, it was already suggested that it may not be ideal. Croft et al (1994) later provided data from a population study to demonstrate that fibromyalgia was not a distinct entity and the logical conclusion was that in studying the epidemiology one should consider its components i.e. chronic widespread pain, tender points etc. separately. The papers in this thesis will therefore study the epidemiology of chronic widespread pain, rather than a clinical diagnosis, and the results reinforce the appropriateness of this approach.

How can the epidemiology of musculoskeletal pain be studied? Unlike a disease such as cancer there are no registration systems which allow us immediately to determine the prevalence and incidence and act as a source of patients for case-control or cohort studies. Although the option of using patients attending primary care or other specialist care facilities may initially seem attractive – there are problems. Not everyone with musculoskeletal pain, even when widespread or disabling, will consult to such services and those that do are likely to differ in important aspects from those who do not consult. For example, it has been suggested that the observation of an association with fibromyalgia and adverse psychological factors may be due to the fact that adverse psychological factors themselves predict consultation, rather than being associated *per se* with fibromyalgia (Aaron et al, 1996). Symptoms may also have been present for a considerable time making the study of onset problematic. There are also problems with the "coding" or "recording" of such information in general practice – the "coding" of a consultation with low back pain alone, on a computerised system, could be one of many possible codes, and similar considerations pertain to other condition such as forearm pain or fibromyalgia. For those reasons the only feasible way to examine the descriptive epidemiology (i.e. burden) and analytical epidemiology (i.e. aetiology) is by studying randomly selected subjects from the general population. This is the approach which will be used throughout this thesis. Pain is a subjective symptom and therefore the studies necessarily rely on self-report information. Data will be gathered by postal questionnaire on large study samples. Where necessary a two-stage sampling procedure is employed with follow-up (e.g. clinical examination) of a sub-set of subjects based on responses to the initial survey.

This thesis on the epidemiology of pain, based on published work, will include studies on regional pain (low back, shoulder, forearm) and widespread pain syndromes. Paper L and the Summary Chapter will present evidence that considering such syndromes together, rather than considering each as a distinct entity, is the correct approach.. The thesis will be presented in four parts. The first relates to the aetiology of symptom onset – it will concentrate on the role of mechanical (injury), psychological and psychosocial factors on symptom onset. The second relates to the predictors of symptom chronicity and examines long-term outcome (mortality). It is important to examine predictors of onset and chronicity separately since their aetiology may differ. For example, it could be hypothesised that mechanical factors (injury) may be important in symptoms onset but that psychological factors are more important in symptom outcome. The third part of the thesis relates to methodological aspects of the previous work: classification of pain syndromes, and influences on health-seeking behaviour. Finally part four will bring some of the previous work and other work together to present an argument that regional and generalised (widespread) pain syndromes should be considered as part of a continuum rather than distinct entities. The summary chapter will then review and discuss further the results from this programme of work and highlight possible areas for future research.

1.2 List of publications included in the thesis:

There are 12 original research articles in the thesis (2 of which are combined into a single paper for the thesis) and 1 invited article in a clinical book series.

The aetiology of regional and widespread pain syndromes

A. Pope DP, Croft PR, Pritchard CM, Silman AJ, **Macfarlane GJ.**
Occupational factors in relation to shoulder pain and disability
Occupational and Environmental Medicine 1997;54:316-321

B. **Macfarlane GJ**, Thomas E, Papageorgiou AC, Croft PR, Jayson MIV, Silman AJ.
Employment and work activities as predictors of future back pain
Spine 1997; 22:1143-1149

Combined with

Papageorgiou AC, **Macfarlane GJ**, Thomas E, Jayson MIV, Silman AJ. Psychosocial factors in the work place - do they predict new episodes of low back pain? Spine 1997;22:10:1137-1142

C. Papageorgiou AC, Croft PR, Thomas E, Silman AJ, **Macfarlane GJ**. Psychosocial risks for low back pain: are these related to work? Annals of the Rheumatic Diseases 1998;57:500-2

D. **Macfarlane GJ**, Hunt IM, Silman AJ.
The role of mechanical and psychosocial factors in the onset of forearm pain: a population-based prospective study
British Medical Journal 2000;321:1-5

E. McBeth J, **Macfarlane GJ**, Benjamin S, Silman AJ
Features of somatisation predict the onset of chronic widespread pain: results from a large population-based study.
Arthritis and Rheumatism 2001;44:940-6

Predicting outcome of regional and widespread pain syndromes

F. **Macfarlane GJ**, Hunt IM, Silman AJ.
Predictors of chronic shoulder pain: A community-based prospective study
Journal of Rheumatology 1998;25:1612-5

G. **Macfarlane GJ**, Thomas E, Papageorgiou A, Schollum J, Croft PR, Silman AJ.
The natural history of chronic pain in the community: A better prognosis than in the clinic?
Journal of Rheumatology 1996;23:1617-1620

H. **Macfarlane GJ**, Thomas E, Croft PR, Papageorgiou AC, Jayson MIV, Silman AJ.
Predictors of early improvement in low back pain amongst consulters to general practice: the influence of pre-morbid and episode-specific factors
Pain 1999; 80:113-9

I. **Macfarlane GJ**, McBeth J, Silman AJ.
Widespread body pain and mortality: a prospective population-based study.
British Medical Journal 2001 (in press)

Methodological aspects of the epidemiological studies conducted

J. **Macfarlane GJ**, Croft PR, Schollum J, Silman AJ.
Widespread pain: Is an improved classification possible ?
Journal of Rheumatology 1996;23:1628-32

K. **Macfarlane GJ**, Hunt IM, McBeth J, Papageorgiou AC, Morris S, Benjamin S, Silman AJ.
Chronic widespread pain in the community: influences on health-care seeking behaviour.
Journal of Rheumatology 1999;26:413-9

The relationship between regional and widespread pain syndromes

L. **Macfarlane GJ**
Generalised pain, fibromyalgia and regional pain: an epidemiological view
Baillière's Clinical Rheumatology 1999;13 (3):403-1

1.3 Epidemiological studies

The data in this thesis is derived from four population-based studies and one occupational study. In each population study participating subjects have been selected from age-sex registers of local general practices. Since over 95% of adults in the United Kingdom are registered with a general practice, this provides a convenient population sampling frame. All four population studies were conducted in the South Manchester or North Cheshire area and brief details are provided below.

1.3.1 The Stockport Shoulder Pain Study (Publications A,F)

A cross-sectional postal survey of 500 adults aged 18-75 years, randomly selected from the age-sex register of a local general practice and stratified by age and sex to reflect the demographics of the local population. Information was collected on current and past shoulder pain. An occupational history was obtained from participating subjects including details of physical activities, environmental conditions and psychosocial factors associated with each employment. Subjects reporting shoulder pain were followed prospectively and re-surveyed 3 years after recruitment to determine predictors of chronic symptoms.

1.3.2 The South Manchester Low Back Pain Study (Publications B,C,H,I)

A postal survey conducted on the registered population aged 18-75 years of two general practices in the South Manchester area (n=7669). Information was collected on current (and previous) low back pain and on possible aetiological factors for the development of a new episode. These principally related to demographic factors, psychological and psychosocial factors, and work-place and leisure physical activities. All participants were re-surveyed one year after recruitment, allowing the predictors of a new onset of low back pain to be determined. In addition participants who consulted their general practitioner during the course of the study year with low back pain, were followed up at 2 weeks, and 3 months post consultation by nurse face-to-face interview and examination. This allowed (using data at the time of recruitment and around the time of consultation) pre-morbid and episode-specific factors of chronicity to be determined.

1.3.3 The North Cheshire Pain Study (Publications G,I,J)

A population-based study involving 2340 subjects aged 18-65 years randomly selected from the age-sex register of two general practices in diverse areas of North Cheshire. Information was collected by means of a self-complete questionnaire on pain experience during the past month. A random sample of 250 respondents, stratified on reported pain status, were selected for further study through self-complete questionnaire, nurse interview and examination. Information was collected on socio-demographic factors, psychological distress, fatigue, sleep disturbance, and other morbidities. Subjects were also examined for tenderness according to the American College of Rheumatology standard criteria. The selected sub-group of subjects were followed prospectively and resurveyed at 2 years to determine their current pain status.

1.3.4 The Altrincham Pain Study (Publications D,E,K)

A 3-year prospective population-based study of 3004 adults aged 18-65 years randomly selected from the age-sex register of a local general practice. Subjects were surveyed by postal questionnaire at recruitment, 1 and 3 years. The pain syndrome of primary interest in this study was "chronic widespread body pain" although there were specific questions relating to forearm pain at the 3 year follow-up. At each survey, information was collected on demographic factors, psychological distress, health anxiety and behaviour, fatigue, and aspects of somatisation. At the 3-year follow-up, a retrospective occupational history was obtained, particular relating to physical activities undertaken. A group of respondents to the baseline survey with high levels of psychological distress, were selected for a structured psychiatric interview. This interview ascertained whether interviewed subjects met criteria for a psychiatric disorder and also explored aspects of early life experiences.

1.4 Ethical approval for conduct of studies

All the studies reported received ethical approval from the ethics committee of the local health authority committee and/or the University of Manchester.

CHAPTER 2:

THE AETIOLOGY OF REGIONAL AND WIDESPREAD PAIN SYNDROMES

2.1 Introduction

This chapter will examine the role of work-place mechanical (injury) and psychosocial factors in relation to the onset of regional pain syndromes: low back pain, shoulder pain and forearm pain. The studies are conducted in general population samples (although they incorporate assessment of workplace factors), and include both prospective cohort and retrospective case-control designs. Paper A examines, within a case-control study, the role of lifetime occupational history (mechanical factors, psychosocial factors and the physical environment) on shoulder pain and disability. Having observed in Paper B that workplace psychosocial factors increase the risk of the onset of low back pain, Paper C examines further whether these associations are specific to the workplace.

The causes of forearm pain, and conditions of which it is a feature, has been a subject of intense controversy. There have been "epidemics" of such conditions in occupational settings and these are not confined to recent times. It was a common condition amongst writers and scribes (writers'cramp) in the early 18th century. In the 19th century the introduction of the telegraph led to pain, numbness and weakness being commonly reported amongst telegraph operators (telegraphists' cramp). More recently in the 1980s, "cumulative trauma disorder" and "repetitive strain injury" have been reported in a variety of occupational settings, with the terms implying that symptoms are a result of mechanical trauma. Paper D is the first study, of which the author is aware, to examine prospectively in a general population, the aetiology of onset of forearm pain.

Finally, the chapter will also examine the role of psychological factors in the onset of chronic widespread pain. While adverse psychological factors have been commonly associated with chronic widespread pain/fibromyalgia in the clinic setting, it has not been established that these are aetiological factors predicting onset. The study presented will consider the specific hypothesis that chronic widespread pain is one feature of the process of somatisation (Paper E).

Two of the papers in this section (Papers D and E) use data from the Altrincham Pain Study. This was a prospective study which collected data at Years 0 (Baseline), Year 1 and Year 3. Paper D on Forearm Pain uses data from Years 1 and 3, while Paper E uses data from Years 0 and 1. Why the inconsistency? This can be explained by the fact that information on both mechanical (injury) factors and forearm pain was only collected in this study at Year 3 (and covered the period between Years 1 and 3). Therefore to examine the relative influences of mechanical and psychological factors on the onset of forearm pain it was necessary to uses the follow-up period between years 1 and 3. However to examine the role of somatisation on the onset of chronic widespread pain, all the required data had been collected in the follow-up period between Years 0 and 1.

2.2 Paper A

Occupational factors in relation to shoulder pain and disability:

a population-based cross-sectional study

Published Article Authors:

Daniel P Pope (1), Peter R Croft (2), Christina M Pritchard (1), Alan J Silman (1), Gary J Macfarlane (1)

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Published Article Reference:

Occupational and Environmental Medicine 1997;**54**:316-21

Abstract

Objectives: To determine, in a population-based study, the influence of occupational factors on the occurrence of shoulder pain and disability.

Methods: A random sample of patients was selected from the register of a general practice in the Greater Manchester area of the United Kingdom. Information was collected by means of mailed questionnaire with specific enquiry about symptoms in the shoulder region and related disability. A lifetime occupational history was obtained including physical exposures, working conditions and psychosocial aspects of each workplace. Analysis has been conducted as a case-control study, comparing occupational exposures at the time of onset of symptoms in those with shoulder pain and disability to corresponding occupational exposures in those without shoulder pain and disability.

Results: An increased risk of shoulder pain in males was associated with carrying weights on one shoulder (RR=5.5, 95% CI (1.8,17)), while those who reported working with hands above shoulder level, using wrists or arms in a repetitive way or stretching down to reach below knee level had approximately twice the risk of shoulder pain and disability. Males working frequently in very cold or damp conditions had a four-fold and six-fold risk respectively of shoulder pain and disability. Reporting of shoulder pain and disability was also more common amongst males and females reporting that their work caused a lot of stress (RR=1.9, 95% CI (0.9,4.1)) or was very monotonous (RR=2.7, 95% CI (1.3, 5.4)). The relationships of shoulder pain with physical exposures, working conditions and psychosocial factors were independent of each other.

Conclusions: This population-based study has shown that physical activities carried out at work, the physical conditions under which the work is conducted and psychosocial aspects of work or the working environment are all independently related to the occurrence of shoulder symptoms and disability, emphasising the multifactorial nature of this condition.

Introduction

Musculoskeletal disorders of the shoulder are relatively common in the general population but are considered to be usually short-lived and not incapacitating (Hadler, 1989). However, quantifying the prevalence of shoulder disorders is difficult given that estimates are highly dependent on the precise definition used. In the Health and Nutrition Examination Survey I, conducted in the United States, a prevalence estimate for shoulder symptoms of 7% was derived from a sample of 6913 adults using a definition of "at least one month of musculoskeletal pain in the shoulder" (Cunningham and Kelsey, 1984). Considerably higher estimates of the occurrence of shoulder symptoms have been found in studies of occupational groups. Silverstein (1985) studied 574 workers in six manufacturing plants in the United States and reported a prevalence of 33% for neck/shoulder pain "occurring more than once or lasting more than one week in the last two years". Similarly high estimates have been found in other occupational settings. Occupational factors which have been associated with musculoskeletal symptoms in the shoulder relate to both physical aspects of the work undertaken as well as "psychosocial factors" concerning work and the working environment. Aspects of work believed to increase the risk of symptoms include physically heavy work, working with arms at or above shoulder level, repetitive movements of the arm and lack of sufficient rest (Sommerich et al, 1993). Occupations which are monotonous, involve time pressure or high workload with little personal autonomy have also been found to have an increased prevalence of musculoskeletal symptoms (Bongers et al, 1993).

The current study is one of a few to use population-based data to examine the influence of occupational factors in relation to shoulder pain and disability. It examines the influence of work tasks carried out, physical working conditions and psychosocial aspects of work, on the occurrence of shoulder pain.

Methods

The study population comprised 500 persons, randomly selected from the register of one general practice in the Greater Manchester area of the United Kingdom. The sample was stratified by age and gender, to reflect the demographic characteristics of the area. A questionnaire was mailed to the sample selected, and included items on the experience of pain during the past month, as well as specific enquiry about symptoms in the shoulder region. All respondents to the questionnaire were then contacted either by telephone or post and permission to interview them sought. At interview the information collected about shoulder symptoms included whether subjects had experienced shoulder pain (i.e. pain in the area delineated in Figure 1) lasting for at least 24 hours in the month prior to interview, and whether they still had shoulder pain at the time of interview. Subjects with shoulder pain were asked to complete a short, 23 item, questionnaire enquiring about disability associated with such symptoms in daily activities. This questionnaire was developed from the Functional Limitations Profile (Patrick and Peach, 1989) and has been validated in general practice and in the community (Croft et al, 1994). Topics covered by the questionnaire include domestic, recreational and psychosocial problems relating to shoulder symptoms.

In addition to information on shoulder pain and disability, data were obtained regarding the current job, and all previous jobs which the respondent had held. For each job, the age at starting and finishing, working conditions, occupational activities and postures adopted were recorded. Occupational activity items were preceded by the question ‘During an average working week do you do any of the following on at least two days per week regularly?’ Thereafter a list of individual activities was given e.g. lift or carry weights of more than 25lbs, and answers were recorded on a dichotomous scale (yes/no). Subjects were asked how frequently they experienced various physical working conditions (e.g. working in moist/damp conditions) or psychosocial factors (e.g. work causing a lot of stress and worry) with responses recorded on a four point scale (never/occasionally/most of the time/always). In order to minimise recall bias the complete occupational history was taken separately from and before any questions on shoulder pain were asked.

Definition of shoulder pain

For the purposes of analysis subjects were classified as having shoulder pain if a) they reported shoulder symptoms (within the area shown on Figure 1) which had been present for at least a 24 hour period during the past month, on the self-complete questionnaire, b) had shoulder pain at the time of interview, and c) had at least one disability resulting from shoulder symptoms as assessed by the disability questionnaire used (Croft et al, 1994). This definition incorporating both pain and disability was chosen in order to exclude those with either transient or relatively mild shoulder pain. Hereafter the term "shoulder pain" will be used to define those meeting the above criteria.

Statistical Analysis

The relationship between aspects of work, the working environment and shoulder pain has been examined by comparing occupational exposures *at the time of onset of symptoms* in those with shoulder pain, to corresponding occupational exposures in those without shoulder pain. The analysis has been conducted using a case-control method of analysis. Cases are those with current shoulder pain as previously defined, while controls are all other subjects in the sample. Accordingly the control group will include those with no shoulder pain, transient shoulder pain and those with shoulder pain but without any resulting disability. For each case, the time since onset of the current shoulder problem has been recorded, and from the occupational history the occupation at the time of onset identified. For the purpose of defining time of onset of current shoulder symptoms, episodes of shoulder pain are defined as continuous if a period without any symptoms has lasted for less than one year. Thus for example if shoulder pain had been experienced episodically over five-years, but without a one-year symptom free interval, the time of onset would be defined as five years ago. If alternatively there had been a one-year pain free period, time of onset would be the time since onset of the most recent episode. Controls have been randomly chosen from sets matched to cases by sex and age-group (18-39, 40-59, 60+years), with a variable matching ratio of, on average, 5:1 for males and 4:1 for females. The comparison occupation used for the control is the occupation being performed at a 'reference date'. The reference date was determined by subtracting from the date of interview the 'time since onset' of shoulder problems of the matched case.

Logistic regression has been used to estimate the odds of disease associated with a given exposure relative to the odds of disease associated with absence of the same exposure (odds ratio). Given however that shoulder symptoms commonly occur in the population, the odds ratio may not be a reliable estimate of the rate ratio i.e. the risk in the exposed group relative to that in the non-exposed group. The odds ratios obtained have therefore been converted to risk ratios (or relative risks) using the method of Osborne and Cattaruzza (1995). Risks are presented together with 95% confidence intervals: where risks are not presented separately for males and females, they have also been adjusted for sex. All analyses were conducted using the statistical package STATA (Stata Corp., 1993)

Results

In total, 312 of the original sample (n=500) responded to the postal questionnaire. After excluding persons who did not receive the questionnaire because they were no longer resident at the address recorded on the GP register (n=29) the overall response to the survey was 66%. Of the 312 respondents, 232 (74%) agreed to an interview by a research nurse which was conducted at a median of 9 months (range: 2-23) after the initial survey; 217 of these subjects were in employment on their reference date. These 217 form the group for analysis in the current manuscript, 39 of whom satisfied the previously defined criteria for shoulder pain. Those with shoulder pain were older (mean age 48 years vs 45 years), more likely to report a long standing illness or disability (44% vs 23%), to have consulted a doctor about a back problem (41% vs 24%), to have had neck pain in the past year (63% vs 40%), and to report "other joint problems" (87% vs 68%) than those without shoulder pain. The percentage of males and females in both groups was similar. Amongst those with shoulder pain, the median duration of symptoms was 3 years (Inter-quartile range: 1-10 yrs) and the most common disabilities reported were "having to change position frequently in bed" (80%), "difficulty carrying things" (59%) and "sleeping less well" (58%).

Working activities

Amongst males, the work activity associated with the largest increase in risk for shoulder pain was carrying weights on one shoulder (RR=5.5, 95% CI (1.8,17.4)). Those who reported having to take rests due to aching muscles/joints (RR=3.0, 95% CI (0.9,9.6)) or having aches and pains at the end of a shift (RR=2.2, 95% CI (0.8, 6.4)) also were more likely to report shoulder pain. Those males reporting "working with hands above shoulder level", "using wrists in a repetitive way", "using arms in a repetitive way" or "stretching down to reach below knee level" had approximately twice the risk of shoulder pain compared to those not reporting these activities, although these increased risks were not statistically significant. Finally there was only a modest increased risk associated with lifting or carrying weights of more than 25lbs (RR=1.2, 95% CI (0.4,3.5)) and no increased risk associated with using vibrating machinery (Table 1).

Amongst females there were no significantly increased risks associated with any of the physical activities recorded, the highest risk being for "using wrists in a repetitive way" (RR=2.0, 95% CI (0.9, 4.6)).

Working conditions

Males working in very cold or in very damp conditions had an increased risk of shoulder pain. For those working 'most of the time' or 'always' in very damp conditions the risk of shoulder pain was increased over five-fold (RR=5.4, 95% CI (1.6,19.0)) and in very cold conditions the risk was increased over six-fold (RR=6.4, 95% CI (1.5, 27.0)). Risk of shoulder pain was also increased, although to a lesser extent, amongst those males exposed to cold or damp conditions 'occasionally' or for 'half working time' (Table 2). No significantly increased risk was associated with females working in such conditions. The risk of shoulder pain was not significantly increased, as might be expected, by working in noisy or dusty conditions, nor by working with fumes. For males there was an increase in risk, although not significant, associated with working in very hot conditions (RR=2.4, 95% CI (0.7, 7.9)). These relationships were not confounded by the specific tasks being carried out, with little change in the risk estimates when assessed together in the same logistic regression model.

Psychosocial aspects of work

Reporting of shoulder pain was more common amongst those persons reporting that their work caused a lot of stress/worry either 'most of the time' or 'always' (RR=1.9, 95% CI (0.9, 4.1)). Similarly an increased risk was noted amongst those whose work was very monotonous (RR=2.7, 95% CI (1.3, 5.4)). In both instances the magnitude of the risk was the same for both males and females. The magnitude of risks remain unchanged after adjustment, in the logistic regression model, for the actual tasks being undertaken and working conditions.

Discussion

This is a small population-based study of shoulder pain and disability intended to generate hypotheses about occupational factors, both physical and non-physical, that may increase the risk of symptoms. The results suggest that shoulder pain and disability are associated with several aspects of employment: working conditions, working activities and psychosocial aspects of work. Risks associated with both working conditions and activities were primarily confined to males. Working with hands above shoulder level, using wrists in a repetitive way, stretching down below knee level and working with bent posture all resulted in a risk at least double those not exposed to such activities, while regularly working in damp or cold conditions or carrying weights on one shoulder increased the risk approximately five-fold. Amongst women there was little variation in the risks of shoulder pain according to working conditions or activities.

The associations of shoulder pain with carrying weights on one shoulder and working with hands at or above shoulder level have been reported previously, with both exhibiting a dose-risk relationship in terms of weight carried and time exposed respectively (Wells et al, 1983; Hagberg and Wegman, 1987; Holmstrom et al, 1992). Whether repetitive arm movements are a risk factor for shoulder pain has been more controversial (Hagberg and Wegman, 1987; Stock, 1991), although Kvarnstrom (1983) found that cases of "occupational cervicobrachial disorder", which has shoulder pain as one of its symptoms, was concentrated amongst workers whose jobs involved short cycles irrespective of the actual physical load of the job. Our study supports the body of evidence suggesting that using vibrating machinery does not result in an increased risk of shoulder symptoms (Gemne and Saraste, 1987), although such a relationship has been previously suggested (Burdorf and Monster, 1991). In addition to these physical exposures, the present study has also reported for the first time that the working environment can have an influence on shoulder symptoms, since those working in a damp or cold environment had a greatly increased risk of having symptoms. While in some of the reported occupations, damp/cold conditions may be unavoidable (e.g. farm worker, gardener, bricklayer, police officer, armed forces), this may not be necessarily so in other occupations performed in such conditions. The observed relationships were not confounded by the actual tasks being carried out, nor by psychosocial aspects of work.

Why should the increased risks in males noted for specific working conditions or activities not also have been observed amongst females? It seems unlikely that, given a similar exposure to working tasks and working conditions, the risk of shoulder pain and disability is substantially lower amongst females. For most activities and "adverse" working conditions the number of females exposed was nearly always considerably smaller than the number of males exposed. This however does not explain the absence of observed risk, but only results in a greater uncertainty about the exact magnitude of risk about a point estimate (i.e. wide confidence intervals). Instead the risk observed in females for a variety of "exposures" are consistently close to those females "unexposed". An explanation for these observations may be that, even when undertaking activities such as carrying weights on one shoulder, working with hands above shoulder level, or working in damp or cold conditions, the "degree of exposure" (e.g. weights carried) was lower for females than for males. An alternative possibility is that other causes of shoulder pain are more important in women and so the impact of occupational exposure is less.

Amongst both male and females, having a job that was reported as either stressful or conversely monotonous was a risk factor for shoulder pain, with an approximate doubling and trebling of risk respectively. Stress at work has been reported in cross-sectional studies to be associated with the occurrence of shoulder/neck symptoms (Ohara et al, 1976; Kvarnstorm, 1983; Ohlsson et al, 1994) and predictive of future symptoms (Veiersted and Westgaard, 1992), while other studies have failed to find a relationship (Bergenudd et al, 1988; Linton and Kamwendo, 1989; Kamwendo et al, 1991). The most consistent associations with symptoms in the shoulder region have been reported with 'demand and control' psychosocial variables (e.g. monotonous work, time pressure, high perceived work load or low control/autonomy). These studies have been conducted in different settings, with different study designs (e.g. cross-sectional, case-control and prospective studies) and using a variety of outcome variables (e.g. self-reported symptoms, medical practitioner diagnosis, sick leave) (Kvarnstorm, 1983; Veiersted and Westgaard, 1992; Linton and Kamwendo, 1989; Linton, 1990; Toomingas, 1992). It is possible that the relationship between psychosocial variables and shoulder symptoms is confounded by "physical" exposure variables. For example variables such as lifting heavy weights, repetitive movements of the arm and working in cold or damp conditions, as well as being risk factors for shoulder pain, might also be related to monotonous or stressful work. However examining this hypothesis in the current study showed that, in men, even after "physical" exposure variables were accounted for, the relationship between psychosocial variables and shoulder pain still existed. In women no such relationship with "physical" exposures was found and therefore cannot be an explanation for the relationship with psychosocial variables.

The current study is one of few to be population-based and not confined only to those who have sought care for shoulder symptoms. It is therefore less likely to be affected by bias in recall of exposures than studies conducted in industrial settings. However only two-thirds of those eligible to participate returned the mailed questionnaire and a further one-quarter of these did not agree to a subsequent interview. Those who did not return the mailed questionnaire were more likely to be male and of younger age. From a review of general practitioner records it was found that these persons were also less likely to have consulted in the previous two years with shoulder problems in comparison to those who returned the questionnaire (Pope and Croft, 1996). Those persons who refused subsequent interview did not differ in their reported experience of shoulder symptoms in comparison to those who were interviewed. However the main findings of our study would change only if the *relationship* between work exposures and shoulder pain differed between participants and non-participants and there is no reason for supposing that this would have occurred.

Many of the studies which have been conducted on occupation and shoulder problems have been cross-sectional and therefore relate occupational "exposures" at the time of interview to current shoulder symptoms. This has the disadvantage that subjects may have changed occupation or work activities as a result of persistent shoulder problems. This leads to the phenomenon of the 'healthy worker effect' whereby those prone to illness may have left an occupation carrying a high risk of illness, and results in an underestimate of the true risk of disease associated with the occupation. This study, while cross-sectional in design, has recorded a lifetime occupational history so that occupation and related activities, working conditions and psychosocial factors *at the time of initial onset of symptoms* could be determined. Finally recall bias, whereby cases are more likely to recall specific "exposures" than controls, can be an important problem for epidemiological studies. It is unlikely to have influenced the current results since a *lifetime* occupational history was obtained and this information was gathered separately from information on symptoms.

In summary, this population-based study has shown that physical activities carried out at work, the physical conditions under which the work is conducted and psychosocial aspects of work or the working environment are all related to the occurrence of shoulder symptoms and disability. Each has an independent effect on the risk of shoulder symptoms emphasising the multi-factorial aetiology of shoulder pain. These findings parallel those reported for occupational influences on low back pain (Skovron, 1992) where physical tasks, physical conditions and psychosocial factors have been found to be important in predicting future occurrences of symptoms. Since musculoskeletal disorders are the leading cause of occupational disability (Putz-Anderson, 1988), effective measures to reduce the frequency of occurrence would have a significant financial implication for industry. While emphasis in prevention programmes to date has been on the effect of heavy physical work, it is clear that this should not be considered in isolation of working conditions and physical and psychosocial environment.

2.3 Paper B

Employment Physical Work Activities and Psychosocial Factors as Predictors of Future Low Back Pain: a population-based prospective study

This paper is an amalgamation of Published Article 1 with selected extracts from Published Article 2:

Published Article 1

Employment and Physical Work Activities as Predictors of Future Low Back Pain

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Reference: *Spine* 1997;**22**:1143-9

Published Article 2

Psychosocial Factors in the Workplace – Do they predict new episodes of Low Back Pain?

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Reference: *Spine* 1997;**22**:1137-42

Abstract

Study Design: A population-based longitudinal study conducted in North-West England over a twelve month period involving adults aged 18-75 years.

Objectives: To determine physical and psychosocial factors related to employment which predict the future occurrence of a new episode of low back pain.

Summary of Background Data: Most epidemiological studies examining the relationship between occupation and back pain have been cross-sectional or retrospective in design. Since workers who have experienced low back pain may have changed jobs or working activities, it is important to use longitudinal studies which define "exposures" prior to the onset of symptoms.

Methods: From adults registered with two general practices in North-West England, 1412 persons who were currently in employment and free of low back pain were identified. A lifetime occupational history was recorded for all such persons together with details of activities performed in each occupation. Information was also collected on social class, psychological distress and psychosocial factors related to their current job. Data on consultations for low back pain during the follow-up year were collected via computerised medical records while those who had not consulted with low back pain were sent a further questionnaire at the end of the one-year follow-up.

Results: In examining physical factors, an increased risk of the future onset of back pain was found in those whose jobs involved lifting/pulling /pushing objects of at least 25lbs, or whose jobs involved prolonged periods of standing or walking. Risks were, in general, greater in females, for a first ever episode of back pain and for back pain which lead to a general practice consultation. No clear relationship between years of exposure to such factors and magnitude of risk was evident. The risk of an episode of low back pain for which a consultation was not sought, doubled in those dissatisfied with their work. Both a perception of an inadequate income and low social status were strongly associated with consulting with low back pain during the follow-up year, an association more marked in women. The associations with work dissatisfaction and perceived inadequacy of income were not explained by high levels of psychological distress or low social status.

Conclusions: Both occupational physical activities and psychosocial factors were related to the future occurrence of low back pain. For physical activities, with which relationships were noted particularly in women, short-term influences may be more important in the occurrence of new episodes rather than cumulative lifetime physical exposures. Psychosocial factors may not only influence the reporting of low back pain but also whether a consultation is sought for symptoms.

Introduction

Low back pain is one of the commonest causes of disability amongst persons of working age, and its impact on industry is enormous. In the United Kingdom, amongst employed persons, it is estimated that 52 million working days are lost per year because of low back pain. One-year prevalence estimates of work loss due to low back pain range from 9% to 20% of employed persons (Consumers' Association, 1985; Walsh et al, 1992; CSAG, 1994). Specific work-related factors hypothesised to influence the occurrence of low back pain include both physical and psychosocial factors.

Physical factors which have been hypothesised to be associated with the onset of low back symptoms include: lifting heavy weights, bending and twisting, working in the same position for long periods of time, repetitive movements and vibration (Andersson, 1981). In epidemiological studies which have examined the relationship with psychosocial factors, dissatisfaction with a job or the working environment has been found in some studies (Bergenudd and Nilsson, 1988; Svensson and Andersson, 1989; Bigos et al, 1991; Skovron et al, 1994) but not all (Svensson, 1983; Astrand, 1987; Biering-Sorenson et al, 1989; Boshuizen, 1993) to be related to the reporting of back symptoms. In addition, general psychological distress has been shown to predict the onset of low back pain (Croft et al, 1995) although the relative importance of this factor may differ, depending on whether a clinic population or self-reported low back pain in an occupational group is being considered (Feyer et al, 1992). The influence of social status on the onset of low back pain (measured as social class, income or years in education) is less clear (Blaxter, 1987; Deyo and Tsui-Wu, 1987; Walsh et al, 1992; Croft and Rigby, 1994).

Most epidemiological studies of low back pain have been cross-sectional or retrospective in design, relating the occurrence of low back pain to occupational "exposures" either at the time of symptoms or in the past (Frymoyer et al, 1980; Riihimaki et al, 1989; Guo et al, 1995; Hildebrandt, 1995). However since individuals who have previously experienced low back pain may have changed occupations or work activities or their environment to those less likely to precipitate or aggravate symptoms, such studies may underestimate the risk associated with some occupations. Conversely there is the potential to overestimate the risk in occupations which are unrelated to the onset of back symptoms. These problems may be overcome, to a large extent, by longitudinal studies collecting information on a cohort of subjects (including back pain history, work activities and psychosocial factors) and then following cohort members prospectively to ascertain future back pain symptoms (Bigos et al, 1992; Pietri et al, 1992).

This manuscript reports on a large prospective study conducted in the South Manchester area, involving 1412 persons who were in employment and free of back pain on recruitment. Information was collected from each cohort member on social status, lifetime occupational history, associated work activities and psychosocial factors. Subjects were thereafter followed over a one-year period and details recorded on any back pain and related health-seeking behaviour during that time

Materials and Methods

Cohort Recruitment

The study population comprised individuals from the South Manchester Back Pain Study. A questionnaire was sent to all 7699 adults aged between 18-75 years, registered with two general practices in the South Manchester area of the United Kingdom. Approximately 95% of persons are registered with a general practice and this therefore provides a convenient population sampling frame. Completed questionnaires were received from 4501 persons (a response rate of 59%) of whom 2916 were currently in employment. Low back pain was defined, from answers to the questionnaire, as any ache or pain lasting longer than 24 hours, in the area bordered above by the 12th rib and below by the gluteal fold. Information was obtained on the presence of current (within the past month) and previous low back pain. Those 1412 persons who were in employment and free of current low back pain on recruitment to the study are the subjects for this analysis.

In addition to information on current low back pain, data were obtained at baseline regarding the current job, and all previous jobs which the respondent had held. For each job the age at starting, age at finishing, and occupation title were requested. Respondents were also asked whether as part of each job they performed the following tasks: 1) standing or walking for more than two hours in total, 2) sitting for two or more hours in total, with or without a break, 3) digging or shovelling, 4) driving a car or van for four or more hours in total, 5) driving a lorry, tractor or digger, 6) lifting or moving weights of 25lb/11kg or more by hand.

Three questions were asked concerning psychosocial aspects of their current employment: How satisfied are you with your present job? Do you have problems getting on with people at work? Is the money coming in adequate for you and your family's needs? Responses for each question were recorded on a four-point scale. Additional information was collected using the 12-item General Health Questionnaire (GHQ) a screening instrument widely used to identify symptoms of psychological distress of recent onset, which has been validated against clinical psychiatric interviews (Goldberg and Williams, 1988). Social class was derived from the current or last reported occupation using the Office of Population Census and Survey's standard classification for occupation and social class (OPCS, 1991), and was available for 98% of this employed cohort. Social classes I and II represent managerial and professional occupations, IIIN (non-manual) includes office and technical workers, IIIM (manual) covers skilled manual workers, and social classes IV and V include unskilled, manual occupations.

Cohort follow-up

Episodes of low back pain, occurring in the 12 month period following the survey, were ascertained using two approaches. Firstly, the two general practices involved in this study used a computerised record system to document all patient visits. Information was available on the reason for each patient consultation, allowing all consultations for low back pain to be identified. Secondly, information on the experience of back pain, but which did not lead to a general practice consultation, was collected by the mailing of a second questionnaire to the remainder of the cohort one year after recruitment. This questionnaire sought information on new episodes of low back pain which had developed in the 12 month period since completing the baseline survey.

Statistical Analysis

Using the job titles provided at the initial assessment, persons have been classified into broad occupational groups. In order to calculate the one-year incidence of low back pain in specific occupational groups, it has been assumed that responders to the follow-up questionnaire are generally representative of the entire 'non-consulting' group in terms of the occurrence of low back pain. The effects of occupation and work physical activities and psychosocial factors, on the occurrence of new episodes of back pain were examined using a case-control method of analysis. Those persons who developed an episode of low back pain in the subsequent year were defined as cases while those who remained free of low back pain during the follow-up period were defined as controls. Analyses were undertaken separately depending on whether or not cases had consulted their general practitioner. In order to estimate the total amount of time, in years, spent by subjects in occupations which involved particular physical tasks a "cumulative exposure" index summed over their working lifetime was calculated, and the effect of such cumulative exposures on the risk of low back pain investigated.

Logistic regression analysis was used to model the relationship between potential risk factors and subsequent low back pain separately by sex, adjusting where appropriate for age. All analyses were conducted using the statistical package STATA (Stata Corp., 1993)

Results

Of the 1412 respondents to the initial questionnaire who were in employment and free of back pain at recruitment, 76% had full-time and 24% part-time employment. Overall 63 cohort members (4.5%; 43 full-time/20 part-time) consulted their general practitioner during the follow-up year with low back pain. From the remaining 1349 subjects, 784 (58%) responded to the mailed questionnaire at 12 months follow-up, with 247 (32%) reporting that they had experienced low back pain during the follow-up year. Those responding to the follow-up questionnaire were slightly older than those not responding (median age 38 years v. 35 years; p=0.01) and the response rate was marginally higher in females than males (61% v. 56%; non-significant). The remaining analyses therefore compare the baseline occupational experience of the 63 'consulting' cases and the 247 'non-consulting' cases with the 537 subjects known to have remained free of low back pain.

Rates of back pain occurrence overall in the follow-up year for males and females who were in employment were very similar at 34% and 35% respectively with a marginally higher consultation rate in females (6%) than males (4%). In males, overall rates of occurrence varied threefold between those with a previous history of low back pain (60%) and those without (19%), while in females the difference was less than two-fold between those with (47%) and without (27%) a previous history.

Incidence rates of low back pain during follow-up year according to occupation on recruitment to the study

The overall rates of low back pain occurrence in diverse occupational groups are striking because of the small difference in rates between those with the highest and lowest rates of occurrence. (There were too few persons consulting with back pain in individual occupational groups for a comparison to be made.) Amongst men, construction workers, security/armed forces personnel, clerical workers and drivers all had reported rates of low back pain of around 40% whilst even amongst those in whom low back pain was least common, such as managers, machine operators, shop workers, the rate of occurrence was still around 30% (Table 3). Amongst women the highest rate (52%) occurred amongst the occupational group "professionals" (e.g. engineers, teaching, legal and health professionals), with high rates (~40%) also reported in domestics, food industry workers and nurses. The lowest rates were approximately 30% and occurred amongst managers, machine operators and clerical workers (Table 3).

Low back pain in relation to work physical activities

The risk of low back pain according to the six reported types of working activities was assessed, firstly comparing those who consulted with back pain and those who did not have any back pain symptoms during the follow-up year (Table 4). The odds of consulting with low back pain were increased among males and females whose job at baseline involved more than 2 hours per shift standing and/or walking and decreased amongst those who spent more than 2 hours per shift seated. These associations were greater in magnitude and statistically significant amongst females. Further, females who reported lifting or moving weights of 25lbs in their current job were over twice as likely to consult a general practitioner with low back pain during the follow-up year. No significant association was found between either digging or driving a lorry/car and consulting a general practitioner with low back pain, although the number of persons reporting these activities (particularly amongst females) was very small.

Secondly, comparing work activities amongst those reporting low back pain not leading to a consultation during the follow-up year with those with no symptoms, there were no significant differences amongst males. In contrast amongst females, the associations already noted amongst consulters were again present i.e. an increased risk with prolonged periods of standing/ walking, and lifting or moving heavy objects, and a decreased risk with long periods of sitting (Table 4).

Although reports of low back pain during the follow-up year represent "new" episodes of pain (since subjects were low back pain free at recruitment), these episodes may not have been the first-ever episode. A further analysis has therefore been carried out using only cohort members who had no previous history of back pain (n=468) to determine the risk of a first-ever episode of back pain (whether leading to a consultation or not) according to occupational activities reported at baseline. Amongst males there was a modest and non-significant increase in the odds of having a first episode of back pain associated with standing/walking for prolonged periods and lifting heavy weights (Table 5). Amongst females, the significantly increased risks associated with standing/walking, or lifting heavy weights and the decreased risks associated with sitting persisted (Table 5).

Risk of back pain associated with work physical activities according to age

When risk of a first-ever episode of back pain was considered by age-groups 18-44 and 45-75 years, the excess risk was entirely limited to the younger age-groups for both standing/walking > 2 hrs (Men OR=1.8 95% C.I. (0.8,3.9); Women OR=1.6 95% C.I. (0.8, 3.2)) and lifting/moving heavy weights (Men OR=1.6 95% C.I. (0.8,3.2); Women OR=2.8 95% C.I. (1.3, 5.9)).

Cumulative occupational physical activity

Finally, for those exposures associated with an increased risk of back pain (standing for more than 2 hours and lifting/moving weights of 25lbs. or over) a possible length of exposure-risk effect was investigated. Cumulative exposure i.e. the number of years for which persons were in occupations involving a given activity, was divided into tertiles of duration and risk in each third compared to those with no exposure to the particular activity. No such trend existed for either sex (Table 6). This remained true whether risk was considered for persons: a) consulting a general practitioner for low back pain, or b) having an episode of low back pain but not consulting a general practitioner. Amongst males exposed to either of these activities the excess risk over those not exposed decreased with increasing duration of exposure, while in females, risk increased over the first two exposure categories but the excess risk was less in those exposed for the longest periods (over 17 years).

Social class, Psychosocial factors at work

Those subjects reporting marked or severe dissatisfaction with work had a two-fold increase in odds of reporting a non-consulting episode of low back pain during the follow-up year. In contrast, those who perceived their income as markedly or severely inadequate had a three-fold increased of odds of consulting with low back pain compared to those who reported their income as adequate. This association was stronger for men (OR 5.8. 95% CI (1.7-19.2)) than women (OR 2.6, 95% CI (1.1-6.3)). The small number of subjects consulting because of low back pain who expressed dissatisfaction with work or problems getting along with work colleagues makes it difficult to draw conclusions, although an association is suggested (Table 7).

No clear association exists between social class and back pain for which no consultation was sought (Table 8). However, an association is observed between social classes IV and V and consulting with a new episode of low back pain in the follow-up year, this being more pronounced for women (OR 7.7, 95% CI 2.1-27.8) than men (OR 2.4, 95% CI (0.6-8.5)).

It could be argued that dissatisfaction with work and income is a reflection of general psychological distress. To examine this, the associations between low back pain and psychosocial factors were re-analysed, adjusting for psychological distress (using the GHQ score in thirds). This resulted in only a slight reduction in the risk of low back pain associated with inadequacy of income and job dissatisfaction, suggesting that the association reported in Table 7 are independent of psychological distress. Risks were unaltered after further adjustment of these relationships for social class – indicating that social status cannot explain the associations shown in Table 7.

The analysis of relationships with psychosocial factors was stratified according to whether a previous episode of low back pain was reported. In those with no history of low back pain, perceived inadequacy of income (OR 2.0, 95% CI (1.1-3.7)) and social class IV/V (OR 1.7. 95% CI (0.8-3.3)) were associated more strongly with onset, than in those reporting previous symptoms.

Discussion

This large prospective population-based study of a cohort initially free of back pain has provided further evidence that occupational factors are related to new episodes of low back pain. While analysis of risk by occupational category provides indicators to potential aetiological factors (e.g. the high risk in construction workers), such broad groupings are likely to classify together workers with heterogenous work activities, patterns and conditions.

Physical factors

In order to more clearly define work-related risk factors it is necessary to consider specific activities conditions and/or environment. In the current study, lifting or moving weights of more than 25lbs (~11kg) and standing or walking for more than two hours during a shift increased the risk of low back pain. These associations were stronger in females and associated with consulting and non-consulting episodes, first and recurrent episodes of back pain. Amongst males these activities were only associated with first ever episode of back pain, and only with a modest increase in risk.

An increased risk of low back pain, amongst those lifting objects over 25 lbs, or pushing/pulling heavy objects, has been a consistent finding of previous studies (Garg and

Moore, 1992; Kelsey et al, 1990; Riihimaki, 1991; Skovron, 1992). Lifting heavy loads is the reason often attributed to back symptoms (Bigos et al, 1986a; Lloyd et al, 1986) and in occupations such as nursing, where lifting heavy weights is a common work activity, rates of low back pain in this study and in others have been reported to be high (Cust et al, 1972; Dehlin et al, 1976; Guo et al, 1995; Harber et al, 1985). The excess risk is considered to be particularly high if the loads are lifted away from the body, with the knees straight, or combined with a twisting movement (Andersson, 1981; Kelsey et al, 1984). The sex difference in risk observed in the current study, with females being at greater risk than males, has not commonly been reported, since many studies have tended to focus on particular occupational groups or industries (which have been primarily single sex) or had too few female subjects exposed to heavy lifting to evaluate risks (Kuh et al, 1993). Results from this study suggest that when exposed to similar heavy loads, women are more likely than men to experience symptoms of low back pain.

This study has not confirmed the hypothesis that sedentary occupations are associated with a risk of back pain; an association which has been reported by some (Magora, 1972; Kelsey, 1975; Andersson, 1981) but not all studies (Frymoyer et al, 1980; Heliovaara, 1987; Kelsey et al, 1984; Hildebrandt, 1995). Indeed an increased risk was associated with those that spent more time *not* sitting i.e. standing or walking (a result which may be related to other activities performed while standing or walking). Interpretation of this type of data when obtained from cross-sectional studies is problematical. Those who have previously experienced low back pain which was exacerbated by work activity may have changed to a more sedentary occupation and an elevated occurrence of pain in such a group may not be directly related to the current job. However such problems are not present in prospective studies which collect information on "exposures" prior to symptoms occurring, and which may also be able to consider first-ever episodes of back pain. It is therefore difficult to conclude at present that a sedentary occupation *per se* is a risk factor for low back pain, although risk may be associated with some additional factor e.g. sedentary occupations where little movement is possible. One such occupation requiring prolonged periods of sitting with little opportunity for movement is motor-vehicle driving. Kelsey and Hardy (1975) first described the association of prolapsed disc with driving "either at work or away from work" in a hospital based case-control study in the United States, and the result has been replicated in other geographical locations using alternative study designs (Magora, 1970; Gruber, 1976; Frymoyer et al, 1980; Frymoyer et al, 1983; Damkot et al, 1984; Brentstrup and Biering-Sorensen, 1987). A recent study on a cohort of commercial travellers in France found that at recruitment to the study self reported low-back pain was significantly related to the time spent driving a car at work and was also related to new episodes of back pain occurring during the follow-up year (Pietri et al, 1992). Those who spent more than 10 hours driving per week had a three to four fold increase in risk of low back pain, although there was no dose-risk relationship evident. Our study provides only limited support for these observations. The occupational group "drivers" had a rate of back pain occurrence in the follow up year (38%) which was only slightly above the overall rate (34%), while there was a modest (non-significant) increase in risk associated with back pain occurrences in the follow-up year which did not lead to a general practitioner consultation, for car driving (more than 4 hours per day) (OR = 1.3, 95% CI (0.7, 2.4) and lorry driving (OR = 1.2, 95% CI (0.5, 3.1). There were insufficient numbers of female drivers to examine this relationship in women.

A surprising aspect of the current results is that (a) excess risk of back pain associated with physical exposures was confined to younger persons (aged below 45 years) and that (b) those with the longest exposure to risk factors for back pain do not have the highest risk of disease. Lower risks of back pain in older persons and those with long exposures to risk factors may arise because persons who have previously experienced low back pain change jobs or work activities. This might be especially true if subjects believed that their work activities were the cause or a contributing factor to symptoms (Cust et al, 1972; Damlund et al, 1982; Lloyd et al, 1986). Those persons exposed at older age or with the longest exposures to risk activities may be, as a group, those who are not susceptible to low back pain and therefore represent a particularly healthy group, the so-called 'healthy-worker effect' (Fox and Collier, 1976; McMichael, 1976) an effect which has previously been observed in an occupational cohort in relation to low back pain (Bigos et al, 1986b). This phenomenon is a possible explanation for the age-effect in the current study of the relationship in males between risk of back pain and length of time exposed to lifting heavy weights or standing/walking for prolonged periods. It would also contribute to the weaker association observed between these activities and low back pain when "new" as opposed to "first ever" episodes were considered. Among females, trends of risk and length of exposure were inconsistent and may reflect different types of occupation and working patterns (41% of female workers were part-time in comparison to 5% of male workers). Nevertheless, even amongst females the data do not support the hypothesis that increasing cumulative physical "exposures" result in a greater risk of back pain.

Psychosocial factors

Although, overall, the relations between psychosocial factors and low back pain were similar in men and women there were two interesting differences in the strengths of these associations. Women, generally, and especially those in social classes IV and V, were more likely than men to seek consultation because of back pain, reflecting gender differences in consultation behaviour. Whereas perceived inadequacy of income was strongly associated with subsequent consultations for low back pain in men, problems with work colleagues was a more pronounced influence for women, suggesting possible gender differences in attitudes toward employment.

The trend between social class and consultation with low back pain has been reported in other studies. These observed a greater risk in men in social classes III (Manual) to V than in women (Walsh et al, 1992; RCGP, 1994) in contrast with the current study. However, these studies were not limited to individuals initially free of low back pain and in employment. These associations could reflect either a real increase in the severity of low back pain due to the physical nature of many occupations classified as social classes IV/V or a delayed return to manual work and terms of employment that require, for example, sickness certification by the general practitioner to claim state benefits. The finding of

Walsh et al (1992) that the social class gradient in consultations for low back pain was independent of the severity of the disorder suggests that the latter could be the case.

People in social class I and II generally receive a higher income than those in social class IV and V, and it could be argued that social class might, therefore, be confounding the relationship between perceived adequacy of income and low back pain. However, adjustment for social class did not alter this association, suggesting that perception of income was independent of occupationally categorised social class. Nor was the strong relation between perceived adequacy of income observed in those consulting, altered by adjusting for level of psychological distress.

These results show that the attitude of employees toward their work influences both the reporting of new low back pain episodes and consulting behaviour. This could be a specific reflection of more general associations between psychological factors and somatic symptoms, including musculoskeletal pain. Most people with low back pain cope with this symptom without consulting to the primary care practitioner. However, when this occurs, it is important that they recognise that psychosocial factors may be important in the onset. Interventions however, specifically in the work-place setting, are not easy to implement and would require the involvement of employers and individuals at all levels in the work-place.

The response rate obtained was similar to other studies of this type, and through the use of a computerised records system in the practices involved, complete information in the follow-up year regarding consultations for back pain was obtained. Amongst those who did not consult their general practitioner with back pain, however, during the follow-up year, approximately 40% did not return a completed questionnaire. If there were major differences between the responders and non-responders in terms of the relationship between exposure history and low back pain symptoms, the lack of information on these persons will have influenced the results. This seems unlikely.

In summary, the study has confirmed, on a population basis, that working activities involving heavy weights confer an increased risk of low back pain, with the magnitude of risk greater in females. Although there was no evidence that prolonged periods of sitting *per se* were important in the aetiology of the disease, a modest increase in risk was found amongst the occupational group "drivers" and those whose jobs involved driving. The magnitude of risks reported in this study, even with physical factors which are thought to be important in the aetiology of back pain, are relatively modest. The results from the analysis of psychosocial factors confirm that they too can have an important influence on onset. They start to clarify the temporal relation between such factors and low back pain and suggest that these may influence the onset rather than being merely consequences of having symptoms. Whether the relations observed with psychosocial factors pertain only to the working population or whether similar associations are found in the non-employed population, are not addressed in this paper. Such questions need to be addressed before the reasons underpinning some of the results reported here can be fully understood. This issue will be considered in Paper C.

2.4 Paper C

Psychosocial risks for low back pain: are these related to work?

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Published Article Reference:

Annals of Rheumatic Disease 1998;57:500-2

Abstract

Objectives: To examine whether psychosocial risks for low back pain, reported in previous studies, are specific to the working population or are more widely relevant.

Methods: A large population-based survey identified subjects free of low back pain, and obtained information on the degree of satisfaction with work (or not-working) and the adequacy of income for their family's needs. New episodes of consulting and non-consulting low back pain were identified prospectively over twelve months. The psychosocial risks for developing a new low back pain episode are examined in employed and non-employed groups separately.

Results: Dissatisfaction with work status doubled the risk of reporting a new low back pain episode in both the employed (odds ratio 2.0, 95% confidence interval 1.2-3.3) and non-employed (OR 2.0, 1.2-3.1). Those perceiving their income as inadequate were at a three-fold risk of consulting for this symptom regardless of their employment status (employed: OR 3.6, 1.8-7.2; non-employed: 3.6, 1.4-9.0).

Conclusion: Psychosocial factors pose similar risks for a new episode of low back pain in workers and the non-employed. This suggests that such influences may not be related solely to work but be a function of general aspects of life. The economic and individual impact of psychosocial interventions in the workplace, therefore, are likely to be limited unless account is taken of the influence of broader non-work-related aspects.

Introduction

Most people will experience pain in the lower back during their life-time (Papageorgiou et al, 1995). However, the increase in sickness absenteeism and disability payments attributed to low back pain in working people has been hard to explain, especially given the contraction of heavy industry over recent years. One potential explanation is the association between psychosocial factors and low back pain identified in work-place based studies (Bigos et al, 1991; Leino and Magni, 1993; CSAG, 1994). In a prospective population-based study, we have shown that psychosocial factors are as (if not more) strongly associated with a new episode of low back pain in workers than mechanical stress at work, independent of psychological distress and social class (Papageorgiou et al, 1997; Macfarlane et al, 1997).

The aim of this analysis is to examine if such psychosocial hazards for a new back pain episode are specific to those in work or are more widely relevant.

Methods

These have been discussed in detail in Paper B and brief details only are given in this paper.

An initial postal survey of all adults (aged 18-75 years) registered with two general practices in south Manchester identified a cohort free of low back pain during the previous month. Information was obtained on past history of low back pain and current employment status. Two specific questions asked: Is the money coming in adequate for you and your family's needs? How satisfied are you with your present job? (or non-employed status?). These questions have previously been included in a primary care-based study of social problems (Corney, 1988). Social class was derived from the last or current occupation, and level of psychological distress from the 12-item General Health Questionnaire (Goldberg and Williams, 1988).

This back pain-free cohort was followed-up over twelve months and two approaches used to capture all new episodes of low back pain: practice records were used to identify consultations for low back pain, and secondly, twelve months after the initial survey a further questionnaire was sent to those not consulting asking if they had experienced pain in the lower back during the past year.

The results, adjusted for gender and age (divided into four groups), are shown as odds ratios (OR) separately for the employed and non-employed. The control group for this analysis were those free of back pain throughout the follow-up year. The results were also examined for potential confounders, namely past history of low back pain, psychological distress (in tertiles), and social class.

Results

The baseline survey identified 2,715 adults free of low back pain, of whom 1,412 were employed full or part-time (47% male, mean age 38 years (standard deviation 13 years)), and 1,303 non-employed (42% male, mean age 53 years (SD 19 years)). Follow-up data were available for 1,668 subjects: 847 in employment (45% male, mean age 39 years (SD 13 years)) and 802 non-employed (43% male, mean age 55 years (SD 18 years)).

The cumulative incidence of new low back pain episodes recalled by the employed and non-employed groups were: consulting 4.4% and 3.6% respectively; non-consulting 32% in both groups.

For both perceived adequacy of income and degree of satisfaction with employment status, and with respect to both consulting and non-consulting new episodes, the non-employed showed similar risks of low back pain to the employed (Table 9). Regardless of employment status, perception of income as inadequate is associated with a three-fold risk of consulting because of back pain during the follow-up year while dissatisfaction with their situation doubled the risk of subjects reporting a new episode of low back pain.

Neither stratifying by a past history of back pain, nor adjusting for psychological distress or social class, made a significant difference to these associations. Furthermore, although the employed group were younger, restricting the non-employed to those under retirement age did not alter the reported results.

Discussion

Most previous investigations of psychosocial risks associated with low back pain in workers have been workplace based and, with few exceptions (Bigos et al, 1991: Leino and Magni, 1993), cross-sectional. In the present study potential psychosocial risks for low back pain were identified in a back pain-free population cohort, clarifying the temporal relationship. Previous studies have used similar questions to ascertain information from employees on their degree of satisfaction with work, and have reported similar associations with low back pain. However, few have elicited comparable information by referring specifically to those not in paid employment, such as the retired, unemployed, etc. as does the instrument used here (Corney, 1988). The question concerning the perceived adequacy of income was identical for both groups.

In common with other population studies, non-responders to the initial survey were younger and more likely to be male. Their overall consultation rate during the following year was marginally lower (6%) than that of responders (7%). The study design enabled data from the initial survey to be compared for responders and non-responders to the 12-month follow-up survey. Non-responders to this were younger, and significantly more likely to smoke and have higher psychological distress scores than responders. However, the validity of the results would only be affected if any systematic bias, should it exist, affected the association between the risk factors and low back pain in employed persons differently from that in the non-employed.

The difference between the one-year cumulative episode incidence of low back pain reported in the follow-up study (32%), and the cumulative consultation rate (approximately 4%) clearly illustrates that most people with a new back pain episode do not consult their general practitioner - only about one in seven choose to do so. This confirms the results of previous studies (Walsh, 1992) and suggests that the association between low back pain and primary care consultation is not direct, but mediated by other factors (Croft et al, 1998).

It could be argued that workers with lower incomes are more likely to consult their general practitioner to obtain the sickness certification necessary for state benefits. However, similar risks in the non-employed make this explanation unlikely. Perception of income as inadequate might not reflect actual income, but could be a more subtle indicator of a propensity to consult, possibly mediated by somatising behaviour (Klein-Hesselink and Spruit, 1992). Dissatisfaction with one's situation might be more directly related to back symptoms, regardless of employment status and reinforces the evidence for the importance of psychosocial risks of low back pain (Bigos et al, 1991; Leino and Magni, 1993, Papageorgiou et al, 1997).

Most reports of back pain in workers refer to the economic impact of the exponential rise in disability payments and absenteeism due to low back pain (CSAG, 1994). Our results suggest that, while psychosocial intervention in the workplace might reduce the economic costs to society of back pain, these effects would be limited if no account is taken of the influence of broader non-work-related aspects. Moreover, for the individual, such interventions may have a limited impact on the overall experience of back pain and consultation behaviour.

2.5 Paper D

The role of mechanical and psychosocial factors in the onset of forearm pain:

a population-based prospective study

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Published Article Reference:

British Medical Journal 2000;**321**:676-9*

*The full article, which is reproduced here, was published on the British Medical Journal website (http://www.bmj.com/cgi/content/full/321/7262/676 accessed 29th May 2001), an abridged version of which was published in the paper journal

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Abstract

Objective: To determine the aetiology of forearm pain. In particular to determine the relative contribution of (a) psychological factors, features of somatisation and health anxiety/ behaviour, (b) work-related mechanical factors and (c) work-related psychosocial factors in its onset.

Design: A 2 year prospective population-based cohort study (with retrospective assessment of occupational exposures)

Setting: Altrincham, Greater Manchester

Participants: 1953 subjects aged 18-65 years.

Outcome measures: New onset forearm pain

Results: At follow-up, 105 (8.3%) subjects reported new onset pain in the forearm lasting at least one day in the past month. Amongst these subjects 67% also reported shoulder pain, 65% back pain and 45% chronic widespread pain. Increased risks of onset were associated with high levels of psychological distress (RR 2.4, 95% CI (1.5-3.8)), reporting at least two other somatic symptoms (RR 1.7, 95% CI (0.95-3.0)) and high scores on the illness behaviour sub-scale of the Illness Attitude Scales. The two work-related mechanical exposures associated with the highest risk of future forearm pain, were repetitive movements of the arm (RR 4.1, 95% CI (1.7-10)) or wrists (RR 3.4, 95% CI (1.3-8.7)) while the strongest work-related psychosocial risk was dissatisfaction with support from colleagues and/or supervisors (RR 4.7, 95% CI (2.2-10)).

Conclusions: This study has emphasised the multi-factorial aetiology of forearm pain in the population. Psychological distress, aspects of illness behaviour and other somatic symptoms are important in predicting onset in addition to work-related psychosocial and

mechanical factors. Misleading terms such as “cumulative-trauma disorder” or “repetitive strain injury” implying a single uniform aetiology should be avoided.

Introduction

The aetiology of forearm pain, and conditions of which it is a feature, has been the subject of intensive controversy (Helliwell, 1999). Some believe it to be integrally related to physical exposures such as frequent repetitive movements of the upper limb, which can be particularly common in some occupational settings. Others take the view that it is often a regional manifestation of a fibromyalgia-type syndrome, and associated with high levels of psychological distress and features of somatisation. At a workshop in 1997, sponsored by the United Kingdom Health and Safety Executive, to propose classification criteria for upper limb syndromes that were potentially work-related, one of the conditions identified was "diffuse forearm pain" (Harrington et al, 1998). However, due to a lack of appropriately designed studies, little was known about its occurrence (outside the clinic setting) or aetiology.

A prospective population based study has therefore been conducted to determine the relative contribution of (a) psychological factors, features of somatisation and health anxiety/ behaviour, (b) work-related mechanical factors and (c) work-related psychosocial factors in its onset.

Participants and Methods

The design was a two-year prospective population-based cohort study (with retrospective assessment of occupational exposures).

Cohort recruitment

The study population was the 1953 participants in a cross-sectional survey which had been conducted one year previously (Hunt et al, 1999). Subjects for the original survey had been adults aged between 18 and 65 years, selected by simple random sampling, from the age-sex register of a single general practice in Altrincham, a commuting suburb in Greater

Manchester. The area in which the study was conducted was mixed in terms of socio-demographic characteristics, and with an age-sex structure similar to that of the whole of the United Kingdom population.

All subjects were mailed a questionnaire at baseline, with up to two further questionnaires mailed to non-responders. It contained a blank manikin on which respondents were asked to shade the site of any pain (lasting at least one day) experienced during the previous month. The information provided by the manikin was coded using a template and subjects who had shaded within the area shown in Figure 2a were considered to have forearm pain. This enabled a cohort of subjects free of forearm pain to be identified, and it is these subjects who were eligible for follow-up. Amongst subjects free of forearm pain, data were obtained on other physical and psychological measures (more detailed information on measures (i)-(iv) are given in Paper E):

(i) the 12-item General Health Questionnaire (GHQ) (Goldberg and Williams, 1988), an instrument which identifies psychological distress.

(ii) the Somatic Symptom Scale (Othmer and DeSouza, 1985), a brief measure of the propensity to present somatic complaints.

(iii) two sub-scales of the Illness Attitude Scales: Health Anxiety and Illness Behaviour (Speckens et al, 1996). High scores on the scales indicate high levels of health-related anxiety and an increased propensity to seek care when experiencing symptoms, respectively.

(iv) other regional and widespread pain syndromes. From the pain manikins included in the questionnaire, subjects with back pain or shoulder pain (experienced during the past month and lasting at least one day) were identified. These were defined according to the body areas shown in Figures 2b and 2c respectively, while the definition of chronic widespread pain used was that of the American College of Rheumatology in their criteria for fibromyalgia (Wolfe et al, 1990).

Cohort Follow-Up

At 2 years follow-up, baseline respondents who had been free of forearm pain, were again mailed a questionnaire, with up to two further questionnaires mailed to non-respondents.

Pain Status

Enquiry was made on forearm pain (again using the area shown in Figure 2a) experienced during the previous month and lasting at least one day. Amongst subjects reporting forearm pain further information was collected on date of onset, radiation to other parts of the upper limb, health seeking behaviour and whether it was associated with disability.

Occupational Exposure

In order to determine work-related mechanical and psychosocial factors experienced at the time of a new onset of forearm pain, retrospective assessment of occupational exposure was necessary. An occupational history for the entire follow-up period was obtained for all subjects. For each job, the following information was requested: date of starting, date of finishing, occupational title, and detailed information on mechanical and psychosocial factors experienced in the job.

Analysis

Subjects free of forearm pain at baseline and who provided data at both baseline and follow-up were included in the analyses. The risk of developing forearm pain associated with each "exposure" was calculated using Cox regression models, and are expressed as Relative Risks (RR). The effects of occupational activities on the occurrence of new episodes of forearm pain were analysed using those subjects who were working during the follow-up period. Amongst subjects who reported forearm pain on follow-up, occupational exposures were defined as those carried out at time of onset. Subjects who did not develop forearm pain were assigned a dummy date during the follow-up year, chosen at random based on the distribution of dates of onset derived from the subjects who developed forearm pain. The work-related exposures were then assessed on the date of onset (forearm pain subjects) and on the dummy date (other subjects). Secondly, in order to determine whether an individual exposure or a small group of exposures could reliably identify a group at high risk of developing forearm pain, those factors which on univariate analysis showed a statistically significant risk were selected as candidate variables for entry into forward stepwise Cox regression models, in each of the dimensions considered.

Results

Of the 1953 subjects mailed at baseline, 1715 returned a completed questionnaire. Excluding from the denominator those subjects who were unlikely to have received the questionnaire (82 no longer at registered address, 1 dead), the adjusted participation rate was 92%. At 2 years follow-up, from the 1715 original respondents, 317 were not followed-up (14 had died, 251 were no longer registered with the general practitioner or were no longer at the registered address, and 52 had reported forearm pain at baseline). The remaining 1398 subjects were mailed a follow-up questionnaire which was completed by 1260 subjects - an adjusted follow-up rate of 90%.

At follow-up, the prevalence of forearm pain was 8.3% (n=105) with little difference between males and females (Table 10). Overall, prevalence increased with age amongst males but not females. Approximately one-third of subjects (34%) reporting forearm pain had consulted their general practitioner with the pain, with a similar proportion (35%) experiencing some related disability. Pain was rarely confined only to the forearm region of the upper limb (9%). In 66% of subjects, pain was also reported in the wrist, 45% subjects reported pain in the hand, and 48% reported pain in the elbow. Regional pain syndromes at other sites were also common amongst those reporting forearm pain: 67%

reported shoulder pain, 65% reported back pain while 45% of subjects satisfied the American College of Rheumatology definition of chronic widespread pain.

Risk factors

Morbidities

Subjects reporting another regional pain syndrome or chronic widespread pain at baseline were at increased risk of reporting new onset forearm pain at follow-up (Table 11). Increased risks for developing forearm pain of between 2-3 fold were observed for those with shoulder pain, low back pain and chronic widespread pain. Table 12 shows the univariate associations of other baseline measurements with new onset forearm pain. Subjects scoring in the middle or highest groups for psychological distress (the GHQ score), who reported ever experiencing at least one symptom on the Somatic Symptom Scale, or with high scores on the health behaviour sub-scale of the Illness Attitude Scales had a significantly increased risk of forearm pain. In contrast, health anxiety showed only a very weak, and not significant, relationship with symptom onset.

Occupational mechanical factors

Of the 105 subjects with forearm pain at follow-up, 42 (40%) subjects reported being in employment at the time of pain onset. Of the 1155 subjects without forearm pain, 740 subjects were in employment on their assigned dummy date. These 782 subjects form the sub-group on whom an analysis of the role of occupational exposures on the onset of forearm pain has been undertaken. The vast majority (84%;n=657) only reported one job during the total follow-up period, 14% (n = 109) and 2% (n=16) had 2 and 3 jobs respectively.

There were moderately increased risks of forearm pain for those who reported that for “half or most of the time” in their job, they were lifting or carrying weights with one or both hands, and pushing or pulling weights (Table 13). There was no increased risk, however, associated with typing for more than 30 minutes without a break. The two mechanical exposures associated with the highest and statistically significant risk of future forearm pain, both related to repetitive movements of the upper limb. The risk associated with repetitive movements of the arms increased from 1.8 (95% CI 0.6-5.1) for occasional exposure to 4.1 (95% CI 1.7-10) for exposure "half or most of the time". Similarly the risks associated with repetitive movements of the wrists were 1.4 (95% CI 0.4-4.2) and 3.4 (95% CI 1.3-8.7) respectively (Table 13).

Occupational psychosocial factors

The strongest psychosocial factor associated with the onset of forearm pain related to the degree of satisfaction with support from colleagues and supervisors (Table 13). Relative to those who were satisfied most of the time, those who were only occasionally/or never satisfied had a risk of 4.7 (95% CI 2.2-10). Subjects who felt that they could rarely make their own decisions at work had double the risk of new onset of forearm pain, while non-significant increased risks were also observed in subjects who felt that their job was too hectic (RR=2.0), too boring/ monotonous (RR=2.5) or caused stress (RR=3.3).

Multivariate Model

In order to ascertain whether, when considered together, a small group of factors collected at baseline could reliably characterise those subjects who would develop forearm pain, further Cox regression analyses were conducted using a forward stepwise model. In the mechanical exposure model, the only factor entered was repetitive use of the arms, while in the work-related psychosocial factor model, only the level of satisfaction with support from supervisor/colleagues was included. The model considering other morbidities and Illness Attitudes included two factors: high scores on the illness behaviour sub-scale of the Illness Attitude Scales and high scores on the General Health Questionnaire (psychological distress). When these four factors were entered into a single multivariate model, all factors remained important independent predictors of the onset of symptoms (Table 14). For each subject, the number of factors (amongst the four in the final model) for which they reported exposure in the highest category was calculated. The prevalence of forearm pain increased from 0.4% amongst those exposed to none of the factors to 15.4% for those reporting all factors.

Discussion

This is the first population-based prospective study examining the epidemiology of diffuse forearm pain. It has shown that it is a common symptom which frequently results in interference with daily activities and/or consultation to a general practitioner. It rarely, however, occurs in isolation. Given its co-occurrence with other regional and widespread pain syndromes it is unsurprising that aetiology is similar. Onset was independently related to psychological factors, aspects of illness behaviour, other somatic symptoms as well as work-related mechanical and psychosocial factors. This remained true even when analysis was restricted to those subjects with forearm/upper limb pain only (data not shown).

The role of mechanical factors in the onset of forearm pain has long been suspected, in particular repetitive movements of the arms and wrists. It is a common symptom in occupations such as writers or keyboard workers who have particularly high exposures (Punnett et al, 1985). Greening and Lynn (1998) in a study of 17 patients diagnosed as having “repetitive strain injury” found symptoms and objective signs consistent with a minor polyneuropathy, while a group of 29 office keyboard workers (the majority without symptoms) demonstrated early signs of the condition. Other studies have demonstrated vascular abnormalities in affected upper limbs (Sharma et al, 1997; Pritchard et al, 1999).

The onset of forearm pain was not related to mechanical factors alone: high levels of distress and adverse psychosocial factors also predicted symptom onset. The strongest psychosocial predictor was dissatisfaction with support form work supervisors or colleagues, but aspects of demand such as stress/worry, job pace and level of interest were also associated (although not statistically significant) with future symptoms. Further, the concept that forearm pain may be one feature of a wider process of somatisation was supported by the observation that subjects who developed forearm pain were more likely to report having previously experienced other somatic symptoms. Similar risk factors have been found for other regional pain syndromes such as shoulder and back pain (Bonger et al, 1993) and are common features of chronic widespread pain and fibromyalgia (Macfarlane, 1999 – Paper L). These observations support the view that in many cases forearm pain may be a regional manifestation of a more widespread pain syndrome.

In summary therefore this study has emphasised the multifactorial nature of forearm pain in the population. It has confirmed a long-suspected relationship with work-related repetitive movements in its onset, but also that the onset of symptoms can be predicted by high levels of psychological distress and adverse work-related psychosocial experiences. Future studies examining and refining hypotheses about the aetiology of diffuse forearm pain should consider each of these domains and misleading terms such as "cumulative-trauma disorder" or "repetitive strain injury" implying a single uniform aetiology should be avoided .

2.6 Paper E

Features of somatisation predict the onset of chronic widespread pain:

a population-based prospective study

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Published Article Reference:

Arthritis and Rheumatism 2001;**44**:940-6

Abstract

Objective. Chronic widespread pain, the clinical hallmark of the fibromyalgia syndrome, is associated with other physical and psychological symptoms both in the clinic and the community. We report the results from the first population based prospective study to examine the hypothesis that psychological and physical indicators of the process of somatisation predict the development of new chronic widespread pain.

Methods. A prospective population-based study. 1658 adults aged 18-65 years completed a detailed pain questionnaire, which included a pain drawing. They also completed the following psychosocial instruments: General Health Questionnaire (Psychological Distress), Somatic Symptom Checklist, Fatigue Questionnaire and the Illness Attitude Scales. Individuals were followed up at 12 months and 1480 (93% of subjects still living at their baseline address) provided data on pain status using the same instruments.

Results. At baseline 825 subjects were classified as pain free and 833 as having pain not satisfying criteria for chronic widespread pain. Of those, 18 (2%) and 63 (8%) respectively were classified as having chronic widespread pain at follow up. After adjustment for age and gender there were strong relationships between baseline test scores and subsequent risk of chronic widespread pain: Somatic Symptom Checklist OR = 3.3, and the Illness Behaviour sub-scale of the Illness Attitude Scales OR = 9.0. All 95% Confidence Intervals excluded unity. These associations were independent of baseline pain status.

Conclusion. Subjects free of chronic widespread pain are at increased future risk of its development if they display other aspects of the process of somatisation. Data from this population based prospective study lend powerful support to the hypothesis that chronic widespread pain can be one manifestation of the somatisation of distress.

Introduction

A challenging problem in clinical practice is the patient who presents with widespread musculoskeletal pain which is unlikely to be explained by an organic pathology. Such patients are often labelled as having “fibromyalgia”, a syndrome whose cardinal symptom, in the presence of a high tender point count, is chronic widespread musculoskeletal pain (Yunus et al, 1989; Wolfe et al, 1990). It has been argued that for epidemiological purposes the key features of fibromyalgia should be treated as continuous, independently distributed variables for which risk factors should be separately identified (Makela, 1999).

Clinic based studies have reported increased rates of depressive (Krag et al, 1994; Celiker et al, 1997), anxiety (Yunus et al, 1981) and somatoform (Bennett et al, 1996) disorders in these patients. These findings may reflect the elevated rates of psychiatric disorder associated with the consultation behaviour of chronic pain patients (Barsky et al, 1986). Indeed, persons with chronic widespread pain who had consulted a medical practitioner displayed higher levels of psychological distress (Macfarlane et al, 1999a – Paper J). However, psychological factors are also apparent in population samples of individuals with chronic widespread pain: associations being reported with other somatic symptoms, psychological distress and, in particular, with measures of depression and anxiety (Croft et al, 1994; Benjamin et al, 2000) and, in a further study, with a measure of hypochondriasis and increased focusing on bodily symptoms (Hunt et al, 1999). Overall these population based studies suggested that chronic widespread pain can be a manifestation of the process of somatisation. Somatisation is the expression of personal and social distress through physical complaints often accompanied by patterns of illness behaviour such as increased medical help seeking for those symptoms (Kleinman and Kleinman,1985). As such it is viewed as a process of illness behaviour rather than a distinct psychiatric diagnostic criteria such as somatisation disorder which may only be the “tip of the iceberg” of true somatisers (Bhui and Hotopf, 1997). The alternative and equally plausible hypothesis is that these features of the process of somatisation are a consequence of chronic widespread pain.

Distinguishing the temporal relationship has been the subject of much controversy (Magni et al, 1994). Understanding the exact nature of the relationship would have implications for both prevention and treatment.

Conclusive evidence of the temporal relationship of these associations can only be established by conducting a population based prospective study. We therefore conducted such a study to test the hypothesis, for the first time, that features of the process of somatisation amongst subjects free of chronic widespread pain predict its future onset.

Methods

Design

The study was a population based prospective postal survey. At baseline, indicators of somatisation were measured on a population of individuals free of chronic widespread pain. Twelve months after the baseline survey, subjects were followed up and new cases which satisfied criteria for chronic widespread pain were ascertained.

Study subjects

A random sample of 3004 subjects aged 18-65 years were selected from a population based primary care register, covering a mixed sociodemographic suburban area.

Questionnaire

Each subject was sent a questionnaire by post which enquired whether subjects had experienced any pain during the previous month that had persisted for at least twenty-four hours and, if so, whether the pain had lasted for more than three months. Four line drawings of the body were included (front, back and sides) on which subjects were asked to indicate the site(s) of pain. On the basis of this information, the subjects were categorised by the presence or absence of chronic widespread pain, using the definition of the American College of Rheumatology (ACR) criteria for fibromyalgia (Wolfe et al, 1990). To satisfy these criteria, subjects must have pain that is present both in two contra-lateral quadrants of the body and in the axial skeleton, and this pain must be present for at least three months. Of the 3004 persons mailed a questionnaire 1953 completed responses were received (75% response rate after adjustment for persons not resident at their listed address, N = 402). Of the subjects who responded 1658 were free of chronic widespread pain and were therefore eligible for follow up. Of those 825 (42%) reported no pain and 833 (43%) reported some pain.

Features of somatisation

The baseline pain questionnaire also included sections to assess aspects of physical complaints, illness attitudes and behaviours, and levels of psychological distress which have been associated with somatisation. These were:

1. *The Somatic Symptom Checklist.* This was originally validated as a screening test for somatisation disorder (Othmer and DeSouza, 1995). The scale includes six items: trouble breathing, frequent vomiting (when not pregnant), loss of voice for more than 30 minutes, being unable to remember what you have been doing for hours or days (without the influence of alcohol or drugs), difficulty swallowing, and frequent pain in the fingers or toes, and an additional item for females: frequent trouble with menstrual cramps. These symptoms are included in the American Psychiatric Associations criteria for somatisation disorder (APA, 1990). In that study a threshold of between 3 and 4 resulted in a sensitivity of 73% and specificity of 94% for identifying cases of somatisation disorder. To avoid spurious associations with new cases of chronic widespread pain only those "non-pain" somatic symptoms were examined (i.e. frequent trouble with menstrual cramps and frequent pain in the fingers and toes were excluded). The total score was therefore between 0 and 5 for both males and females.

2. *The Illness Attitude Scales (IAS).* The nine IAS (Kellner et al, 1987) assess attitudes and concerns about illness and health. Each scale includes three items, each scored from 0 to 4, providing a total score between 0 and 12. Individual scales assess worry about health, concern about pain, health habits, hypochondriacal beliefs, thanatophobia (fear of death), disease phobia, bodily preoccupation, treatment experience and effect of symptoms. A recent study (Speckens et al, 1996) based on a principal components analysis demonstrated that the IAS measures two dimensions reflecting 'health anxiety' and 'illness behaviour'. The 'health anxiety' sub-scale consists of 11 items (such as "Are you worried that you may get a serious illness in the future?") and has a total score between 0 and 44 with a general population mean score of 9.1 (standard deviation = 6.9). The 'illness behaviour' sub-scale consists of 6 items (such as "Do your bodily symptoms stop you from working?") and has a total score between 0 and 24 with a general population mean score of 4.7 (standard deviation = 4.2).

3. *General Health Questionnaire.* The twelve item version of the General Health Questionnaire (GHQ) (Goldberg and Williams, 1988) was included as a measure of psychological distress. Each item has four possible responses but for scoring these were dichotomized at the midpoint and given a score of 0 or 1. Scores for individual items are summed to give a total score ranging between 0 and 12 with high scores indicating higher levels of psychological distress.

4. *Fatigue Questionnaire.* The Fatigue Questionnaire (Chalder et al, 1993) is an 11-item instrument developed for use in population studies to measure physical and mental aspects of fatigue, a feature commonly observed in many somatising patients. Each item has four response options. In a similar manner to the GHQ, scores for individual items were dichotomized at the midpoint and these individual scores are summed to provide a total score between 0 and 11, with high scores corresponding to high levels of fatigue.

Follow up

The 1658 subjects free of chronic widespread pain at baseline were mailed an identical questionnaire after 12 months. The same methods for categorising pain were used as those for the baseline survey. The observer categorising pain status was blind to subjects' baseline pain status, measures of somatisation and all other information included in the baseline questionnaire. New chronic widespread pain at follow up was defined using the ACR definition as discussed above.

Statistical analysis

Those subjects who provided complete data at baseline and follow up were included in the analysis. The distribution of the baseline psychosocial scale scores was not Gaussian. Thus subjects scoring zero on the GHQ and Fatigue scales were classified as one group (the referent group) with the remaining subjects split into thirds of distribution of their scale scores to produce three approximately equal sized groups. For the IAS sub-scales, subjects' scores were divided by thirds. The association between new chronic widespread pain and the scale scores of those subjects scoring in the middle and highest thirds were compared to those in the lowest third. Since no significant heterogeneity was evident in the associations by age and gender (Mantel-Haenszel tests for heterogeneity $p>0.05$) (Mantel and Haenszel, 1959) the results are presented as odds ratios (OR) with 95% confidence intervals (CI) adjusted for age and gender. Under the rare disease assumption, the OR provides a valid estimate of the relative risk. Those risk factors associated with chronic widespread pain were entered into a multiple logistic regression model to examine the relative contribution of those to the presence of new chronic widespread pain. All analyses were conducted using STATA (Stata Corp., 1993).

Results

Response rates and study subjects

At 12 month follow up, 1480 subjects (636 males, 844 females) returned the questionnaire. After adjustment for those subjects who had moved to another address or died and therefore did not receive a questionnaire (N = 73; 36 reported no pain and 37 reported other pain at baseline), the response rate was 93%. Complete baseline and follow up data was available for 95% (N = 1404: 608 males, 796 females) of these subjects. Although the follow-up rate was very high, the effect of non-participation bias was assessed by comparing the baseline characteristics of those 1404 subjects who responded with the 297 who were lost to follow up (Table 15). Non-participants were younger but did not differ on any of the variables measured.

Point prevalence of chronic widespread pain at follow up

Of the 1404 subjects who at baseline did not have chronic widespread pain, 81 subjects reported new chronic widespread pain (prevalence = 5.8%) at follow up with higher proportions in women (Table 16) and older subjects (Table 17).

Predictors of new chronic widespread pain

Those subjects scoring in the highest range of the GHQ were twice as likely to have new chronic widespread pain symptoms when compared to those scoring in the lowest (Table 18). Subjects scoring in the top third of the Illness Behaviour Scale were almost nine times more likely to have chronic widespread pain at follow up while reporting three or more somatic symptoms was associated with a 4-fold increase. Multivariate analysis indicated that the two most important predictors of Illness Behaviour Scale and somatic symptoms scores were independent predictors of onset (Table 18).

In the population studied, who at entry were free of chronic widespread pain, a substantial proportion nevertheless reported some pain at baseline. It was expected that such individuals would be at greater risk of reporting chronic widespread pain at follow up. This was indeed the case: 63 (8%) of those with some pain at baseline were classified as having chronic widespread pain at follow up compared with 18 (3%) of those with no pain. We then investigated whether there was a difference in the strength of the association in the baseline predictors in those two groups. The results showed that the odds ratios for both the Illness Behaviour Scale and reporting more somatic symptoms were, in fact, greater in those with no pain. On formal testing, however, there was no evidence of significant heterogeneity (Mantel-Haenszel tests for heterogeneity, $p > 0.05$).

Finally, it was determined how well these predictors of onset could identify a population group at high risk. Firstly it was determined for each subject at baseline whether they were in the group with the highest scores on the 'Illness Behaviour' scale and/or 'Somatic Symptom Checklist' scale. Importantly, this analysis indicated that only a negligible proportion (1.4%) of those subjects who scored in the lower ranges of both of these scales had new chronic widespread pain at follow up compared to 21% of those with the highest scores in both scales (Table 19).

Discussion

Previous work had indicated that in both clinic samples and in the general population, chronic widespread pain was associated with high levels of psychological distress, particularly depressive, anxiety and somatoform disorders and with features of the process of somatisation such as measures of hypochondriasis. However the temporal relationship between these features and the development of chronic widespread pain had not been established.

In the present population-based prospective study the hypothesis that features of the process of somatisation could predict new chronic widespread pain has been examined for the first time. It was found that indicators of somatisation measured at baseline predicted the development of new chronic widespread pain in the following 12-month period. The strongest predictors were a high score on the Illness Behaviour Scale (which is characterised by frequent visits to medical practitioners and treatment for symptoms that disrupt normal activities), and reporting a greater number of somatic symptoms. These findings provide strong support for the hypothesis that chronic widespread pain is one manifestation of the process of somatisation.

One third of persons with new chronic widespread pain were male, a higher proportion than normally reported in fibromyalgia clinic studies. However recent population based studies of fibromyalgia have shown that although fibromyalgia is indeed more prevalent in females when compared to males, the sex ratio is lower than in the clinic (Makela and Heliovaara, 1991). This discrepancy may be exaggerated in clinic populations due to consultation or referral behaviour. It may be that females with fibromyalgia are more likely to consult a health practitioner with symptoms and/or are more likely to be referred.

It is important to note that the majority of those subjects who displayed these features did not report new chronic widespread pain at follow up. However, in the absence of these features the prevalence of new chronic widespread pain was negligible. It is of interest for future studies to determine why, in the presence of these strongly predictive features of somatisation, only a proportion of subjects develop new chronic widespread pain.

In interpreting these results a number of methodological issues must be considered. First, this study identified a group of subjects who were free of chronic widespread pain at the time of the baseline survey. However, it would be naive to assume that these persons may not have experienced such pain before. Both pain and psychological distress are frequently recurrent in nature. The strength of the present study is in demonstrating that for those persons free of chronic widespread pain but who displayed features of the process of somatisation a significant proportion could be classified one year later as having widespread pain which persisted for at least three months. More importantly, in the group of subjects who did not have chronic widespread pain *and* who did not display any of these features of somatising behaviour, only a negligible proportion went on to develop chronic widespread pain symptoms.

Second, some subjects, who had new chronic widespread pain in the intervening months but which had then resolved between the baseline and follow up surveys, may have been missed. In the present study, prevalent cases of chronic widespread pain were identified at two time points and the measures of the process of somatisation were examined to determine their predictive ability of prevalent cases at follow up. Information on the intervening months was not available. Nevertheless, both clinic and population based studies have indicated that a large proportion of cases of chronic widespread pain persist over years. It is unlikely that we have missed many cases of chronic widespread pain which developed and then resolved during the twelve month period. It would be of interest to determine whether, over a longer period of follow up, the associations observed in the present study remain consistent.

Third, the classification criteria for chronic widespread pain are necessarily arbitrary. For example, at baseline, subjects would only have satisfied the criteria if their pain was both widespread and had been present for at least three months. The features of the process of somatisation identified may not be associated with new chronic widespread pain *per se* but instead associated with other pain which subjects had at the time of the initial survey. However, this does not appear to be the case since in the present study these features of somatisation were not more strongly associated with new chronic widespread pain in those subjects who reported other pain at baseline.

Finally, there is the issue of non participation bias. Of the subjects eligible for follow up and mailed 93% participated. Complete data was available for 95% of those subjects. Although these participation rates are high, they do not exclude the possibility of non participation-bias, albeit the effect would require to be large to affect the study results. As is usual with postal surveys, those who did not participate were more likely to be younger subjects. However, they did not differ on any of the important psychological predictors of the development of new episodes of chronic widespread pain. Thus it is unlikely that the non participation of these subjects would effect the present results. The external validity of the study is also influenced by the follow up sample being restricted to the 75% of subjects who responded to the baseline questionnaire, although this would not have affected the internal comparisons.

Three recent population based prospective studies have examined the association of a formal diagnosis of a psychiatric disorder and the presence of regional pain symptoms. Depression has been found to predict the onset of headache and chest pain after three years (von Korff et al, 1993a). In a study of over 2000 subjects it was observed that current depression was associated with the onset of new episodes of chronic regional musculoskeletal pain (Magni et al, 1994). Similarly, in a study of over 3000 subjects, psychiatric disorder was found to predict the onset of new episodes of back pain, chest pain and abdominal pain (Hotopf et al, 1998). Whether these episodes of pain were short-lived transient events or chronic is unknown. The present study is the first to examine specific aspects of the process of somatisation and has expanded upon these previous findings by identifying specific psychological factors and patterns of illness behaviour which predict the development of new chronic widespread pain. Importantly on multivariate analysis it was the indicators of somatisation, rather than the presence of psychological distress that were the key predictors. This study has also identified that in the absence of such predictors persons will not develop chronic widespread pain symptoms.

In summary, the present population-based prospective study has demonstrated for the first time that in a group of persons free of chronic widespread pain, features of the process of somatisation, including reporting somatic symptoms and patterns of illness behaviour, were important predictors in identifying persons who developed chronic widespread pain. Since the aetiology of these syndromes is unknown, the identification of a sub-group whose symptoms are a manifestation of the process of somatisation of psychological distress has obvious benefits for the health care burden posed by such persons.

CHAPTER 3 :

PREDICTING OUTCOME OF REGIONAL AND WIDESPREAD PAIN SYNDROMES

3.1 Introduction

Chapter 2 has examined, principally, the risk factors for onset of regional and widespread pain syndromes. Chapter 3 will examine the outcome (or natural history) of pain syndromes, and particularly risk factors for chronicity. Why should this later aspect of their epidemiology be considered separately? There are several reasons:

1. *The public health burden*: Many pain episodes experienced by individuals will be transient with only minor (if any) consequent limitation of activities. These symptoms are of less interest to the epidemiologist than more chronic episodes that result in disability. It is these chronic episodes which represent an important burden both for the individual and society, particularly in terms of occupational and health care costs.

2. *Aetiology*: The aetiology of symptom persistence may not necessarily be the same as the aetiology of symptom onset. A simple, hypothetical, example illustrates this. Amongst a workforce of a construction company, mechanical load (injury) may be a common factor in the onset of shoulder pain. Once injured a worker is removed to other duties and determinants of recovery may principally relate to individual and constitutional factors.

3. *Treatment*: In the same way as understanding aetiology, identification of factors leading to chronicity (or conversely recovery) is particularly relevant to informing potential treatment. For example, at the time of presentation to the general practitioner with low back pain – can one predict which patients are likely to experience chronic

symptoms, on the basis of identified factors associated with persistent symptoms? One or more of these factors may provide the basis for management.

This section of the thesis considers predictors of chronicity for shoulder, low back and chronic widespread pain. Paper F examines data from a prospective study of shoulder pain in the community. Amongst persons with shoulder pain at the time of baseline survey, it examines what factors predict subjects who still report shoulder pain when resurveyed approximately 3 years later. Paper G reports a study of similar design in which subjects who participated in a survey/examination were re-surveyed approximately 2 years later. Initially subjects were classified as having No pain/Regional Pain/ Chronic widespread pain and the paper examines a) the stability of pain symptoms and b) amongst subjects with chronic widespread at baseline what factors predict the persistence at follow-up

Paper H follows prospectively patients consulting in general practice with a new episode of low back pain. It reports from a study with a unique design. All the subjects who consult with a new episode of low back pain have previously completed a postal questionnaire which has collected information on pain, psychological factors, workplace mechanical and psychosocial factors as well as general lifestyle information. Further the consulters have been examined by a nurse shortly after consultation. This therefore, in examining factors influencing the natural history of symptoms after consultation, has allowed the role of not only episode-specific factors but also pre-morbid factors to be examined.

Finally, little is known about the long-term natural history of widespread body pain. It is understood that an organic basis for symptoms is found in only a small proportion of cases, and that symptoms in the short and medium term are likely to persist or recur. But what are the long-term consequences, and do they have an impact on mortality? Given that these symptoms are often associated with high levels of psychological distress, do they result in an excess of non-disease related causes of death such as accidents, violence and suicide? Are they a marker for general ill-health? Paper I looks at the long-term outcome, in terms of mortality, of regional and widespread pain syndromes.

3.2 Paper F

Predictors of chronic shoulder pain:

a population-based prospective study

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Published Article Reference:

Journal of Rheumatology 1998;**25**:1612-5

Abstract

Objective: To determine the natural history of shoulder pain in the population, and predictors of outcome on the basis of clinical and individual factors. In addition to determine whether outcome is influenced by the definition of shoulder pain used.

Methods: A prospective cohort study, over a three year period, of subjects recruited from a cross-sectional population study of shoulder pain, conducted in the Greater Manchester area of the United Kingdom.

Results: Of 92 subjects classified as having shoulder pain in the cross-sectional study 50 (54%) reported shoulder pain at follow-up, approximately three years later. In 90% of cases this was accompanied by some disability specifically relating to the symptoms. Baseline factors which predicted symptoms at follow-up were: pain (indicated on a manikin) within a more narrowly defined shoulder region, shoulder pain related disability, pain on the day of examination, symptoms lasting more than one year and high levels of psychological distress.

Conclusion: Shoulder pain in the population is a long-term disabling symptom, although many subjects do not seek an early medical consultation. Disability (independent of whether there was restriction of movement on examination) is a strong predictor of continuing symptoms. The outcome observed in epidemiological studies of shoulder pain will be influenced by the initial definition of symptoms.

Introduction

Episodes of shoulder pain presenting in general practice are generally persistent and associated with continuing disability (Croft et al, 1996; van der Windt et al, 1996). Most episodes of shoulder pain, a common symptom in the population, do not however present to general practice (Pope et al, 1997). The natural history of such symptoms in the population is not known but these non-consulting episodes may be milder and associated with a better prognosis than those which present to general practice. Defining shoulder pain in epidemiological studies is problematical - it is necessary (a) to define the shoulder area (b) to decide the method for recording information on pain, for example, by means of a body manikin or use of subjects' self-reports of "shoulder pain", and (c) to determine whether more "serious" episodes of shoulder pain can be defined by incorporating information on associated disability.

The aim of this prospective population study amongst subjects with shoulder pain was to determine the natural history of symptoms in the population. In addition the study examines whether long-term outcome could be predicted on the basis of clinical (pain-related) and individual (host-related) factors, and to what extent outcome depends on the definition of shoulder pain used.

Materials and Methods

Design

The general design was a prospective cohort study of subjects, over a three year period, recruited from a cross-sectional population screening study for shoulder pain.

Cross-Sectional Study

The cross-sectional study has previously been described in Paper A. Briefly, it involved two stages: firstly, a mailed questionnaire sent to 500 subjects aged 18-75 years randomly chosen from persons registered with a general practice in the Greater Manchester area of the United Kingdom and secondly interview and examination of respondents. It identified 135 individuals who reported shoulder pain either currently or during the previous month.

Subjects were considered to have shoulder pain if i) they reported pain during the previous month in the pre-shaded area of the manikin shown in Figure 3a (upper trunk and neck area), and/or ii) by indicating on a blank manikin, pain during the previous month within the shoulder-specific area shown in Figure 3b and/or iii) responding positively to the question: *Do you have shoulder pain today?* The study also collected information on the onset and duration of shoulder symptoms, whether subjects had consulted their general practitioner with symptoms and an assessment of the level of psychological distress using the General Health Questionnaire 12 item version (GHQ) (Goldberg and Williams, 1988). The level of disability specifically because of shoulder symptoms was determined using a previously validated questionnaire (Croft et al, 1994). This 22-item schedule includes items on domestic, recreational and psychosocial problems in relation to shoulder symptoms. An examination of movement for each painful shoulder was assessed in 6 planes (elevation, forward flexion, external rotation, internal rotation and a composite movement of adduction and internal rotation called "thumb on spine" (Pope et al, 1996)) by a single research nurse, who had been trained in the examination of shoulder movement. An initial evaluation of the examination technique showed both high intra-observer reliability and inter-observer reliability when compared against trained medical practitioners.

Follow-up

Subjects were mailed a follow-up self-complete questionnaire at a median of 35 months (Inter-quartile range (IQR):33-36 months) after the screening survey. At follow-up, subjects were asked whether they had experienced shoulder pain during the past month and those with pain completed the same shoulder disability questionnaire.

Analysis

Univariate analyses, using logistic regression (with adjustment for age group and sex) identified clinical and host factors associated with shoulder pain at follow-up. Thereafter a forward stepwise logistic regression analysis determined whether, when considered in combination, such factors could better predict chronicity of symptoms. The predictive ability of the final model was tested using a jack-knife method (Kleinbaum et al, 1988). In this method the outcome of a subject is predicted based on a model derived using all other subjects in the data set.

Results

At follow-up, 24 of the 135 subjects reporting shoulder pain on the original survey questionnaire were no longer registered at the same general practice nor on the electoral register of the area. The remaining 111 subjects were mailed a study questionnaire and 92 agreed to participate representing 83% of those mailed and 68% of the original study population with shoulder pain. Those not participating in the follow-up stage of the study were younger than participants but did not differ significantly with respect to any other information collected at the baseline interview and examination.

Shoulder pain definition

Of the 92 subjects who were successfully followed-up, at baseline 89 had indicated pain in the pre-shaded upper trunk and neck region (Figure 3a), 72 subjects indicated pain within the specific shoulder area on the blank manikin (Figure 3b) and 62 reported shoulder pain on the day of interview. The number of subjects satisfying each criteria and combination of criteria is shown in Figure 4. At follow-up, overall 50 subjects (54%) reported shoulder pain, with the highest rates of pain amongst those who, at baseline, had pain in the more narrowly defined shoulder area or pain on the day of interview/examination (Figure 3b). The highest rate of shoulder pain at follow-up was observed amongst those who satisfied all three criteria at baseline.

Disability

Of the 50 subjects with shoulder pain at follow-up, 45 (90%) reported at least some disability arising from symptoms. Amongst subjects with continuing disability there was a median increase of 2 (IQR: 0-6) in the number of disabilities reported in comparison to recruitment. The most frequent disabilities reported at follow-up were sleeping problems and/or physical disabilities: changing position frequently in bed (68%), difficulty carrying things (52%), moving arm or hand with difficulty (48%), sleeping less well (48%) and difficulty reaching things (48%).

Predictors of Outcome

On univariate analyses the strongest predictors, at baseline, of pain on follow-up were: shoulder pain related disability, pain on the day of examination (both statistically significant), a long duration of symptoms, pain within the specific shoulder region, older age and a high score ($\geq$ 5) on the GHQ (all with increased odds of symptoms but not statistically significant). Consulting a general practitioner with symptoms (a possible marker of severity) also predicted future symptoms. In contrast, restriction of shoulder movement in one or more planes was not associated with a significant increase in risk of pain at follow-up. (Table 20).

On stepwise regression analysis (which excluded information on whether a subject had consulted a general practitioner since this was not considered to be a meaningful predictor variable) the combination of independent factors (adjusted for each other) at baseline which best predicted symptoms at follow-up were: pain on the day of baseline examination (OR=3.1, 95% CI (1.1,8.2), symptoms lasting more than one year (OR=2.9, 95% CI (1.1,7.7) and more than five shoulder pain related disabilities (OR=3.1, 95% CI (0.9,11)). The estimated positive and negative predictive values of the model were 62% and 53% respectively, with overall 58% of subjects correctly classified.

Discussion

This prospective population study has shown that more than half of subjects with shoulder pain on recruitment also had shoulder pain on follow-up three years later. In almost all cases this was associated with physical and/or sleep-related disabilities. Croft et al (1994) found similar evidence of persisting symptoms and disability amongst those consulting a general practitioner with a new episode of shoulder pain - 51% still reported symptoms 18 months later. It is interesting that in the current study, only 37% of subjects with shoulder pain at recruitment reported having consulted a general practitioner with symptoms. Similar high prevalence rates of disabling shoulder pain but low rates of medical consultation have been reported from a population survey in Norway (Hasvold et al, 1993) and of elderly residents in the United Kingdom (Chard et al, 1991).

The current study is one of the first to examine predictors of chronicity. With respect to shoulder pain, we used definitions which were intended to include both pain within the specific shoulder area and pain which may be radiating from the shoulder area. Although pain within the shoulder specific region may not always be attributable to the shoulder joint, it is noteworthy that this was a strong predictor of having "shoulder pain" at follow-up. Greater (reported) disability at baseline, having consulted a general practitioner and reporting pain specifically on the day of interview, all may be a reflection of initially more severe conditions and were strong predictors of continuing symptoms. Similarly, symptoms of long prior duration were likely to remain chronic. Individual factors associated with continuing symptoms included psychological distress, which has previously been associated with the onset of shoulder symptoms (Bergenudd et al, 1988). These results indicate that such distress may also affect the natural history of symptoms. In contrast, the value of measuring range of shoulder movement is limited to providing information on likely current disability.

This prospective study has shown that in the population, shoulder pain represents a long-term disabling symptom. Although many subjects with pain do not seek an early medical consultation, their symptoms are likely to persist in the long-term. While shoulder pain related disability is a strong predictor of future symptoms, a restricted range of movement in one or more planes does not adversely affect long-term outcome in terms of pain. Finally, defining pain within the shoulder specific region in addition to some associated disability appears to be suitable for use in epidemiological surveys in defining "significant" symptoms.

3.3 Paper G

The Natural History of Chronic Pain in the Community – a better prognosis than the clinic?

a population-based prospective study

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Published Article Reference:

Journal of Rheumatology 1996;**23**:1617-20

Abstract

Objective: To evaluate the predictors of improvement at 2 years in subjects with chronic widespread pain ascertained from a community survey.

Methods: As part of a community-based epidemiological survey on the occurrence of pain, 141 subjects (age-range: 24-74 years; 44 men 97 women) were selected for more detailed assessment. Subjects were categorised according to whether they had no pain, chronic widespread pain (according to the American College of Rheumatology criteria), or regional pain, both at initial assessment and follow-up. In addition, subjects were examined at both time periods for tender points.

Results: Of those with chronic widespread pain at initial assessment, 35% still had chronic widespread pain at follow-up, 50% regional pain and 15% no pain. Of those originally with regional pain, 65% still had regional pain, 19% chronic widespread pain and 16% no pain at follow-up. Logistic regression analysis was conducted to examine factors amongst those with chronic widespread pain associated with still having these symptoms at follow-up. Female sex, older age, leaving school at a young age, high tender point count, high levels of fatigue, or additional physical or psychological symptoms were all associated with symptoms being less likely to resolve.

Conclusion: Chronic widespread pain in the community has a generally good prognosis. However, those with additional symptoms associated with the fibromyalgia syndrome were more likely still to have chronic widespread pain 2 years later.

Introduction

Despite evidence that chronic widespread pain is common, little information is available on the natural history of the condition. Hospital and specialist clinic series suggest it is a difficult condition to treat and pharmacological (analgesics, anti-inflammatory drugs, antidepressants) and non-pharmacological (physical activity, educational programs) therapies appear rarely to result in rapid recovery (Carette, 1995). However, such series are dominated by persons with a long history of symptoms and many associated features of chronic widespread pain. We are unaware of any study that has followed in a community setting to determine the chronicity of symptoms.

This paper describes results from a follow-up of subjects selected from general practice registers who agreed to participate in a study over 2 years about the occurrence of pain. Outcome is considered among those who satisfy criteria for chronic widespread pain and the influence on outcome of the presence or absence of associated physical and psychological factors and tender point on examination.

Materials and Methods

The study was conducted among the registered population of 2 general practices in Cheshire. A total of 1340 subjects (75% of those who received an invitation to participate) completed a postal questionnaire about any pain during the previous month lasting more than 24 hours. The site of any pain was recorded on line drawings (front, back, left and right views), and information collected on the total duration of pain. From the original survey responders a sample of 250, stratified according to pain status (no pain, regional pain, chronic widespread pain) were invited to be examined for tender points by a research nurse using the criteria of the American College of Rheumatology (ACR) (Wolfe et al, 1990). A designated point was recorded positive if pain was reported by the subject when pressure of 4kg was applied. Subjects completed further questionnaires that included items on pain assessment, associated symptoms, sleep problems (Jenkins et al, 1988), psychological distress (The General Health Questionnaire – 12 item version) (Goldberg and Williams, 1988) and a Fatigue Questionnaire (Chalder et al, 1993). Both the General Health Questionnaire and Fatigue Questionnaire were self-administered after interview and examination. The sleep problem questions were interviewer administered. This assessment was carried out up to 12 months after the first postal survey; the 177 respondents represent a 71% response rate, which did not vary markedly by pain status.

The 177 subjects participating were re-contacted at a median of 27 months (range 15-35 months) after initial assessment, at which time they were requested to complete similar questionnaires to those previously used and to undergo a second tender point examination by the same research nurse. This follow-up includes persons who reported "no pain", since it was of interest to examine the effect of any reported psychological symptoms or presence of tender points on the development of future pain.

Statistical analyses involved descriptive tabulations of change in pain status and logistic regression to examine the effect of associated physical and psychological factors on the likelihood of pain symptoms changing. All statistical analyses were performed using the STATA statistical package (StataCorp, 1993).

Results

Of the 177 subjects who participated at the initial evaluation, 141 (80%) could be contacted and agreed to participate in the follow-up assessment. The 36 subjects who either could not be contacted or did not agree to participate in the follow-up study did not differ from those participating with respect to age, sex or pain status. The subjects included in the follow-up assessment (44 men, 97 women) had a median age at initial assessment of 52 years (range 24-74) and at initial examination 33 reported no pain, 34 had chronic widespread pain according to the ACR criteria, and 74 regional pain.

Table 21 gives information on the categorisation with respect to pain status of the 141 subjects at baseline and follow-up. Of the 33 subjects initially with no pain, 10 (30%) reported regional pain at follow-up, and the remainder again had no pain; of those initially with regional pain 14 (19%) reported chronic widespread pain and 12 (16%) no pain at follow-up while the remaining 48 (65%) again reported regional pain. Only 12 of 34 subjects (35%) with chronic widespread pain at baseline still had symptoms at follow-up; 17 (50%) now had regional pain and 5 (15%) reported no pain. The median interval between baseline and follow-up examination was 27 months, but the proportion of subjects with chronic widespread pain and regional pain who changed pain categories was similar, irrespective of whether the re-examination was earlier or later than the median.

Of the 34 subjects with chronic widespread pain at baseline, 15 also had more than 11 of 18 tender points on examination, and were thus classified as having fibromyalgia according to ACR criteria. From this group only 8 of 14 (57%; one person did not have an examination for tender points) satisfied these criteria at follow-up. The remaining 6 subjects were all classified as having regional pain at follow-up. Conversely, 7 persons newly satisfied the ACR criteria for fibromyalgia at follow-up, all previously having had regional pain.

Follow-up of subjects with chronic widespread pain

Subjects with chronic widespread pain whose symptoms remained at follow-up, in comparison with those whose symptoms had improved, were older (mean age 61 vs. 52 years), more likely to be female (92 vs. 73%) and had left school earlier (median age 15 vs. 16 years) with fewer reporting educational qualifications (50 vs. 68%) (Table 22). Three-quarters of those who did not improve indicated that the "aches and pains" had started more than 10 years ago, compared with half those who subsequently had no widespread pain.

Subjects were more likely to have chronic widespread pain at follow-up, if at original assessment they had any of the following: 11 or more tender points on examination, a high score on the General Health Questionnaire or the Fatigue Questionnaire, or if they reported either problems with sleep, micturition problems, abdominal pain, or headaches (Table 23). After adjusting for the effects of age-group and sex, any of the above symptoms or signs increased the odds of pain symptoms not improving by at least 3-fold, although with relatively small numbers only the increased odds associated with sleep problems were statistically significant.

Similarly among those who were pain-free at initial assessment there were wide confidence intervals around all point estimates due to small numbers of subjects and the lack of additional symptoms reported, as would be expected, among those with no pain.

Discussion

The finding that only 35% of subjects with chronic widespread pain still had the condition when followed-up between one and three years later is a surprising result from our study, the first population-based follow-up study of widespread pain to be reported. The improvement in symptoms in a large proportion of subjects can be compared to 19% of subjects with pain previously regional in nature, reporting chronic widespread pain at follow-up. Prevalence rates in the community of regional pain (43%) and chronic widespread pain (13%) reported previously from this study (Croft et al, 1994) would suggest that the rates of improvement and worsening of pain would result in an approximately constant prevalence of chronic widespread pain over time.

However, the prognosis in persons with chronic widespread pain is less favourable when accompanied by other psychological and physical symptoms. The presence of 11 or more tender points (therefore satisfying criteria for fibromyalgia) increases 5-fold the odds of symptoms not improving, while micturition problems, abdominal pain, sleep disturbance, fatigue, as well as psychological symptoms, all associated with fibromyalgia, similarly worsen prognosis. The effect of these other psychological and physical symptoms may not be independent from that of number of tender points, since these other factors have been shown to be related to the tender point count (Croft et al, 1994). Unfortunately, the number of subjects in our study is insufficient for analysis of the effect of these other psychological and physical symptoms, by controlling for number of tender points. Nevertheless, it can be concluded from the above that among subjects with chronic widespread pain there will be a "dynamic pool" of those without concomitant symptoms whose pain in the short-term may well improve partially or completely, and a "static pool" of those with associated symptoms of fibromyalgia whose pain is less likely to resolve. Yet even among persons in our community based study who initially satisfied criteria for fibromyalgia, only 8 of 14 (57%) were classified as having fibromyalgia at follow-up.

Our study was conducted within 2 general practices and had a high participation rate; 71% of those selected to participate from the initial survey responders agreed to do so, and the response rate was roughly equal irrespective of pain status. At follow-up, 80% of subjects were able to be contacted and agreed to participate. It is therefore likely that, within each pain category, the subjects who participated in this follow-up study were representative of the population from which the sample was drawn, and it could be hypothesised that, if bias was to occur due to non-response, it was more likely to occur in those without pain rather than those with continuing pain.

Studies of patients attending hospital or specialist referral centres have suggested that symptoms persist, and may also have been present for a considerable time before diagnosis (Yunus et al, 1981; Campbell et al, 1983). Among a group of 39 clinic patients with fibromyalgia followed for 2 years, 60% were found to have a moderate or severe symptoms throughout this period (Felson and Goldenberg, 1986). Hawley et al (1988) in a study of 75 patients with fibromyalgia from the American Rheumatism Association Medical Information System (ARAMIS) database, who met the criteria of Yunus et al (1981) and additional criteria on tender points, found severity of symptoms and pain to be remarkably stable over a 12 month period. In contrast, a study conducted in Australia among 44 consecutive patients with fibromyalgia (satisfying the criteria of Smythe and Modolfsky (1977)) referred to 2 private rheumatology practices (and excluding those receiving psychological or psychiatric support) found that 47% did not fulfil the criteria at 2 years follow-up (Granges et al, 1994). Although the criteria for diagnosis of fibromyalgia were not the same at initial assessment and at follow-up, this is unlikely to have had a major effect on the result.

The observation that the chronicity of symptoms associated with widespread pain or fibromyalgia may differ between patients seen in rheumatology clinics and when all cases in the community are considered is likely to be explained by severity of symptoms. Although satisfying criteria for the disease, those persons in the community who have not sought medical care or who have not been referred to a specialist centre may have less severe symptoms or their symptoms may be less disabling. If less severe symptoms were more likely to resolve, as seems a reasonable hypothesis, this may account for some of the differences noted. This hypothesis is supported by results from a follow-up survey of persistent pain sufferers in Canada (Crook et al, 1989). At 2 years' follow-up, the percentage of patients whose symptoms had resolved was much greater in those sampled from family practices (36%) than in a group attending a specialist pain clinic (13%).

It is of interest in this study that among 34 subjects initially with chronic widespread pain, over three-quarters reported their "aches and pains" had lasted more than 6 years and half reported symptoms for over 10 years. Surprisingly, even among those whose chronic widespread pain "improved" (17 persons now reported regional pain and 5 no pain) symptoms had been present for over 6 years in more than 60% of persons. This suggests that either (a) symptoms, although generally present over a long period, vary on a day to day basis, (b) the criteria for widespread pain are too loose to define a group of patients whose pain is truly widespread, or that (c) widespread pain in the community is largely a symptoms that resolves within a 2-year period.

In summary, while chronic widespread pain in the community has been shown in this study to have a generally good prognosis, an additional high tender point count (i.e. symptoms sufficient to meet ACR criteria for fibromyalgia) was associated with more persistent symptoms. Female sex, low educational achievement, high scores on questionnaires designed to measure psychological disturbance and fatigue, sleep disturbance, micturition problems, abdominal pain and reporting headaches were also associated with chronicity of pain symptoms, although whether the effect of these is independent of that associated with a high tender point is not clear. This population study has also shown that a much lower proportion of patients with chronic widespread pain have persistent symptoms than suggested by previous studies based on clinical series of patients. Future research should establish whether a sub-group of patients currently diagnosed with chronic widespread pain may be identified whose symptoms are likely to resolve in the short-term, and conversely others who are likely to have chronic symptoms. In this way, effective interventions could be targeted at specific patient groups early in the history of symptoms.

3.4 Paper H

Predictors of early improvement in low back pain amongst consulters to general practice: the influence of pre-morbid and episode-related factors:

Published Article Authors:

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Published Article Reference:

Pain 1999;**80**:113-9

Abstract

Background: Low back pain symptoms are extremely common, affecting as many as 80% of the population at some time in their lives. However the majority of the medical costs arise from the minority of patients whose symptoms become chronic.

Aims: A model is proposed that chronicity is determined not only by factors related to the episode of low back pain, but also factors prior to the onset of symptoms (pre-morbid factors). No previous study has collected information on predictors of low back pain chronicity prior to the onset of symptoms.

Methods: Participants in the South Manchester Low Back Pain Study, recruited by means of a cross-sectional population survey were followed prospectively over eighteen months to identify those who consulted their general practitioner with a new episode of low back pain. At interview, 1-2 weeks post-consultation, it was determined whether or not subjects' symptoms had improved.

Results: In males, low levels of psychological distress, a higher than average reported level of physical activity, being in employment, and being satisfied with current work status were associated with a quick improvement in symptoms. In addition factors related to the episode, namely a short duration before consultation and symptoms with a sudden onset and confined to the lower back area, also strongly predicted a good early outcome. Using information on both pre-morbid and episode related factors, groups of male patients were identified whose probability of an early resolution of symptoms ranged between 0.25 and 1. Few factors, either pre-morbid or episode-related, were strongly associated with outcome amongst females.

Conclusions: This large population-based study has shown, despite the known heterogeneity in causes of low back pain and the pathologies associated with symptoms, an

early improvement in symptoms amongst male attenders at general practice can be predicted on the basis of a small number of variables.

Introduction

Low back pain is estimated to affect at least 60% and perhaps as many as 80% of the population at some time in their lives, while cross-sectional surveys commonly find between 15-40% of the population reporting current symptoms (Svensson and Andersson, 1983; Biering-Sorensen, 1984; Svensson and Walsh 1992; Mason 1994; Skovron et al 1994). However, fewer than 10% of the approximately 23 million episodes of low back pain occurring annually in the United Kingdom lead to a general practitioner consultation. Amongst those consulting, it is believed that 50% will have improved within one week and 90% within one month (CSAG 1994; Coste et al 1994). The major part of the cost of back pain, estimated to be £500 million annually to the National Health Service in the United Kingdom and $25 billion in direct medical costs in the United States (Frymoyer and Cats-Baril 1991), is from the small proportion of persons with low back pain whose symptoms become chronic, and there is therefore a need both clinically and in terms of health care planning to distinguish sub-groups of the population who are more prone to develop long-term episodes.

Previous studies have examined prognostic factors measured *during* an episode of low back pain. However in this paper, a model is proposed that chronicity is determined not only by factors related to the episode of low back pain, such as distribution or duration of pain, but also factors *prior to the onset of symptoms* ("pre-morbid" factors). No previous study has reported information on predictors of low back pain chronicity prior to the onset of symptoms. The lack of such information is principally due to the difficulty of collecting such information and then reliably determining the future onset of symptoms. However, the organisation of the health care system in the United Kingdom whereby residents are registered with a general practitioner to whom they will initially consult for health care, allows firstly a convenient population sample to be identified and secondly is a reliable means of identifying consultations for low back pain.

As part of the South Manchester Low Back Pain Study participants in a cross-sectional population survey were followed up over the subsequent eighteen months to identify those who consulted their general practitioner with a new episode of low back pain. Information on demographic, health and lifestyle, employment, and psychological factors was collected at recruitment, that is prior to the onset of low back pain symptoms for which consultation was sought. Secondly information about the low back pain episode was collected soon after consultation. The objective of this analysis is to determine whether information on pre-morbid and episode-specific factors, both separately and together, can reliably predict who will have an early improvement of low back pain symptoms.

Methods

Cohort recruitment

Some aspects of The South Manchester Low Back Pain Study have previously been described in detail in Paper B. In brief, 4501 adults (2616 females, 1885 males), aged between 18-75 years, registered with two general practices, completed a mailed questionnaire which collected information on factors which had previously been related either to the onset or outcome of low back pain: history of low back pain, self-perception of general health, self-reported height and weight (allowing Body Mass Index (BMI) to be derived), employment factors, and aspects of lifestyle such as general level of physical activity and smoking status. An assessment was made of psychological distress using the General Health Questionnaire (GHQ) 12-item version (Goldberg and Williams 1988) with each item scored from 1 to 4 (total score 12-48). Subjects were also asked how satisfied they were with their present work status (i.e. being in employment, working full-time in the home, seeking work or retired) and the perceived adequacy of their income. Social class was derived from information obtained about employment, using the classification of the Office of Population Census and Surveys (OPCS 1991).

In addition, information was obtained on whether subjects currently had low back pain symptoms (defined as symptoms lasting more than 24 hours during the past month). The area bordered above by the 12th rib and below by the lower gluteal folds was defined as the lower back, and shown in the questionnaire as a shaded area on a body manikin.

Cohort follow-up

Using computerised records of the general practices, all first consultations for an episode of low back pain symptoms amongst participating subjects in the 18 month period following recruitment, were continuously ascertained. Consulting subjects were subsequently contacted by a research nurse and permission sought for an early interview and examination. The median time between consultation and interview was 1 week (Interquartile range - (IQR) 1-2 weeks). The post-consultation interview ascertained details about the back pain episode including timing of symptom onset, duration between symptom onset and consultation, current symptoms (including the distribution and severity of pain), and the perceived cause of the episode of low back pain symptoms. Subjects reporting at least one previous episode of low back pain, were also asked about the usual duration of an episode.

The primary outcome was whether or not subjects reported low back symptoms to have improved at the post-consultation interview.

Statistical Analysis

The analysis examined the relation between short term outcome and (i) pre-morbid factors and (ii) current episode factors, amongst those whose "consulting episode" of low back pain started *after* recruitment. Univariate analyses were conducted separately for males and females, using unconditional logistic regression, with adjustment for age. Those variables significantly associated with early improvement of symptoms were thereafter entered as candidate variables in a backward stepwise logistic regression analysis in order to determine a group of pre-morbid and episode-related factors independently associated with good short-term outcome. The ability of such a model to identify which patients would report early improvement was tested using a jack-knife method (Kleinbaum et al 1987). In this method all data relating to one subject is removed from the study data set and a "new" best-fitting model calculated. Using this model, the removed subject is classified according to both the actual (observed) and predicted (from the model) outcome status. This process is then repeated removing each individual observation in turn and thereafter classifying their observed and predicted outcome. The performance of the models overall is determined by considering the observed and predicted classification of all subjects, and thus ensures that data from individual subjects does not contribute to determining the model which will be used to predict their outcome.

All statistical analyses have been conducted using the STATA statistical software package (StataCorp, 1997).

Results

During the 18 months follow-up period 174 (9%) male and 268 (10%) female respondents consulted their general practitioner because of low back pain. Of these 442 consulters, 294 (67%) were able to be contacted and gave permission for interview. At interview, 1-2 weeks post-consultation, 178 (61%) reported that their low back pain symptoms had improved, including 13 whose symptoms had completely resolved. The cumulative improvement was similar in both sexes (males: 62%, females: 59%). In 48 of the 294 interviewed subjects, the episode of low back pain for which consultation was sought had started *before* study recruitment. Subsequent analyses therefore exclude these subjects and are based on 246 (99 male; 147 female) subjects whose low back pain symptoms for which consultation were sought started *after* completing the recruitment questionnaire.

Differences were observed between males and females in the relationship between pre-morbid, episode-related factors and early outcome, and the results are presented separately:

Males

In males several pre-morbid factors were associated with early improvement of low back pain symptoms: low levels of psychological distress (measured by the GHQ), self-rated health as either "excellent" or "good", a higher than average reported level of physical activity, a high BMI, being in employment, and satisfaction with current work status. Older subjects were less likely to have an early improvement in symptoms, although the difference was not statistically significant (Table 24). There was no relationship evident between outcome and the other variables considered, including a previous history of low back pain, nor (amongst those who had a previous history) with self-reports of the usual duration of symptoms.

Of the episode-related variables considered (i.e. information gathered at the post-consultation interview) a short duration of symptoms was the strongest predictor of early improvement. Other episode-related factors which were associated with a good short term outcome were: a sudden onset of the pain, pain localised to the back, and perceiving symptoms not to be work-related (Table 25).

A stepwise regression model was used to determine if a small number of variables when considered together could reliably predict an early improvement of symptoms. Candidate variables for the model were those pre-morbid and episode related factors which were significant on univariate analysis. This model included a low levels of psychological distress as a strong predictor of a good outcome, together with three episode-related factors: a short duration of symptoms prior to consultation, a sudden onset of symptoms and perceiving that symptoms were not related to work (Table 26). This combined model was estimated to correctly predict outcome in 84% of subjects (Positive Predictive Value (PPV) =87%, Negative Predictive Value (NPV)=71%) in comparison to a correct prediction rate of 66% which could be expected by chance. Considering the number of these factors present in an individual, the observed probability of early improvement is shown in Table 27. Those subjects with all four factors (low levels of psychological distress (GHQ score <=21), sudden onset of symptoms, duration of less than 4 weeks prior to consultation, and symptoms unrelated to work) showed a 100% rate of early improvement, while those with none or only 1 factor showed only a 25% rate of improvement.

Females

Amongst females, only weight (in the highest third of the distribution) was significantly associated with a good short-term outcome. Although many of the factors noted to be associated with outcome in males showed effects in the same direction for females, the size of any effect was considerably lower (Table 24). Similarly for episode-related factors, although short duration was associated with good outcome, the strength of the association was much weaker than observed in men, with the odds of early improvement amongst those with symptoms of less than 4 weeks duration prior to consultation being approximately twice those with a longer duration (Table 25). On stepwise regression analysis there was no variable or group of variables which could predict early symptom improvement better than would be expected by chance.

Discussion

Studies estimating rates of improvement for low back pain episodes, in diverse populations (e.g. general practice consulters, clinic attenders, those undergoing a specific treatment) and using varying definitions (e.g. resolution or improvement in pain, return to work) consistently show that many episodes of low back pain resolve quickly with only a small proportion becoming chronic. Waddell (1987) estimates that 90% of back pain episodes resulting in work loss have resolved sufficiently within six weeks to allow a return to work, and those not resulting in work loss would be expected to resolve even quicker. The 61% cumulative rate of improvement at 1-2 weeks post-consultation observed in this study does confirm a rapid improvement in symptoms in the majority of cases, although in only a minority of cases had symptoms completely resolved.

This study has the advantages of being population-based, of studying a large unselected population and of following participants prospectively. Uniquely, subjects were recruited prior to the onset of low back pain for which consultation was sought. We have shown that both pre-morbid and episode-related factors determine the likelihood of symptom improvement. The strongest pre-morbid predictors of outcome in males were psychological and psychosocial factors. It has previously been shown in this study that pain-free individuals with high levels of psychological distress, and those who are dissatisfied with their current work status, are at greater risk of developing a future episode of low back pain (Croft et al 1995; Papageorgiou et al, 1997 - Paper B), but the current results suggest that if such individuals do develop low back pain their symptoms are much less likely to improve quickly. Previous studies have also found that adverse psychological factors are predictive of low back pain symptoms becoming chronic and/or disability (Lee et al 1989; Cherkin et al 1996; Dionne et al 1997). However in these studies, subjects were recruited, and information collected, after the onset of low back pain symptoms (sometimes a considerable time after onset), and the adverse psychological factors measured may have developed as a consequence of symptoms. The results of the current study, namely that adverse psychological factors precede the onset of symptoms, are consistent with studies of chronic musculoskeletal pain in general which have found psychological and psychosocial factors to be important in the aetiology of symptoms (Magni et al 1994; Pope et al 1997), rather than just a consequence of chronic pain symptoms. It is surprising however that the relationship between these factors and outcome was clearly evident only in males.

Higher than average levels of physical activity in males (in comparison to males of the same age) were associated with an early improvement of symptoms. The mechanism of such an effect may be physical e.g. due to strengthening of muscles or increased suppleness with regular exercise, or may be due to both the physical and psychological benefits of regular exercise. In a quasi-experimental study of nurses, those undertaking exercise to increase aerobic fitness not only had shorter duration of back pain episodes, but also reported an increase in job satisfaction (which has itself been shown to be result in a lower risk for back pain) (Kaplan and Deyo 1988). In contrast, physical activity was not strongly related to short-term outcome amongst females. This may be due to the frequency or level of physical exercise (about which information was not collected) being lower amongst females and therefore conferring less benefit in terms of recovery from low back pain.

A perception of poor health and being a current smoker, both of which have shown a definite relationship with the onset of new episodes of low back pain (Croft et al 1995) were also associated with continued symptoms in males. The association of smoking with symptom onset has been attributed both to pressure on the back from chronic coughing and to reduced vascularisation of the disc, and in either case it would be expected that symptoms having arisen would not quickly resolve. In contrast heavier weight and higher body mass index, which have been noted in the current study to be associated with the onset of low back pain, particularly in women, were associated in both sexes with symptoms of short duration. Such observations may be reconciled if heavier subjects are more prone to frequent short episodes of low back pain rather than more chronic episodes.

Episode-related factors were also important in determining outcome from low back pain in both males and females. The strong association between a short duration of symptoms and early improvement is consistently reported. In a United Kingdom based general practice study, subjects who had not improved two months after the onset of symptoms were much more likely to have long-term symptoms (Klenerman et al 1995), while in a further study, recruiting subjects from an orthopaedic out-patient practice and an occupational setting, duration of symptoms prior to consultation was a strong predictor of outcome at 1 month (Burton and Tillotson 1991). It is also reflected in the known inverse association between time off work with low back pain symptoms and probability of returning to work. Studies on low back pain patients with referred pain to the leg, which may be an indication of nerve root compression or irritation in the spinal or root canal, generally show that symptoms are more protracted and, in particular, less likely to resolve in the weeks following consultation (Pedersen 1981; Chavennes et al 1986; Cherkin et al 1996). A poorer short-term prognosis in those who believe that work-related factors were responsible for back pain may be due to either more severe episodes, to the perception that an early return to work may worsen symptoms, or to the possibility of compensation for the injury or symptoms (Lee et al 1989; Coste et al 1994).

There are two important groups of non participants in the current study, when considering whether the results can be extrapolated to the population from which the participants were drawn. Firstly, consulters with low back pain who had not responded to the recruitment questionnaire could not provide pre-morbid data. A sample of 50 such consulters were interviewed by a research nurse, and the short-term outcome in this group was very similar in comparison to all the study participants (58% non-responders improved compared with 61% responders). In addition the main "back pain" predictor of early symptom improvement in this small group, considering males and females together, was a short duration of symptoms. Secondly, some consulters who had completed a recruitment questionnaire were not interviewed. This was primarily because they did not consent to be interviewed (83%), were not able to be contacted (9%) or were not contacted for logistical reasons (9%). Consulters who were not interviewed, in comparison to those interviewed, were more likely to be female, not married, and to be in the youngest (<30 years) or oldest (>=60 years) age-groups. However there was little difference in variables which were predictors of outcome in the main study group, such as GHQ score (level of psychological distress). Overall therefore these data do not suggest any significant biases in relation to short-term outcome in extrapolating the results from the *participating* population to the population *eligible* to participate.

The ability to differentiate those patients who will have early improvement in symptoms on the basis of items easily obtained at consultation is both clinically and economically useful. Pre-morbid levels of psychological distress have been shown to be strongly related to outcome and provides convincing evidence that distress is not solely a consequence of the pain episode. In females, we have shown that the information collected on pre-morbid and episode-related factors, and in particular those factors which were associated with outcome in males, did not predict outcome well. This reflects either the necessity to use more detailed instruments for collecting information relating to the low back pain episode and psychosocial factors, or the importance of other, as yet unknown, influences on outcome.

3.5 Paper I

Widespread body pain and mortality:

a prospective population-based study

Published Article Authors:

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Published Article Reference:

British Medical Journal 2001; 323: (in press)

Abstract

Background: Widespread body pain is the cardinal symptom of the fibromyalgia syndrome, and has a prevalence of between 7-11% in the population. Symptoms are disabling, persistent and difficult to treat. There have been no studies on the long-term consequences of such symptoms. This study aims to determine whether subjects who report widespread body pain experience excess mortality, and if so to establish the nature and extent of any excess.

Methods: 6569 subjects participated in two pain surveys in North-West England during 1991-92. They were classified according to their reported pain status, and were subsequently followed prospectively over 8 years to determine their vital status. The subsequent mortality rates of subjects reporting regional and widespread pain was determined relative to those with no pain. Mortality Rate Ratios (MRR) were adjusted for age-group, gender and study location.

Findings: 1005 (15%) subjects were classified as having widespread pain, 3176 (48%) regional pain and 2388 (36%) as having no pain. Relative to subjects reporting no pain, those with regional pain (MRR 1.21 95% CI (1.01,1.44)) and widespread pain (MRR 1.31 95% CI (1.05,1.65)) both experienced significant excess mortality during the follow-up period. The excess mortality amongst subjects with regional and widespread pain was almost entirely related to cancer deaths: regional pain (MRR 1.55 95% CI (1.09,2.19)) and widespread pain (MRR 2.07 95% CI (1.37, 3.13)). The excess cancer mortality was

maintained after exclusion of subjects with a cancer diagnosis prior to the time of original survey, and after adjustment for potential confounding factors. There was also an excess of deaths from non-disease causes (e.g. accidents, suicide, violence) amongst subjects with widespread pain (MRR 5.21, 95% CI (0.94, 28.78)) although the wide confidence intervals reflect that this was an uncommon cause of death in this cohort.

Interpretation: This study has shown an intriguing relationship between the report of widespread pain and subsequent death from cancer in the medium and long-term. This has implications for the long-term follow-up of patients with "unexplained" widespread pain symptoms, such as those with the fibromyalgia syndrome, but future studies will require to confirm this association and to investigate hypotheses about possible mechanisms.

Introduction

Widespread body pain is the cardinal symptom of the fibromyalgia syndrome. It is commonly reported in the general population: studies have demonstrated that the one-month period prevalence is approximately 9-10% (Croft et al, 1993; Wolfe et al, 1995; Andersson et al, 1993; White et al, 1999). The symptom is associated with high levels of psychological distress, features of the process of somatisation, and co-morbidities, such as fatigue (Hunt et al, 1999). Although widespread pain is common, little known about the natural history of the disease. Studies of clinic patients with fibromyalgia have suggested that it is a difficult condition to treat, and symptoms resolve infrequently (Hawley et al, 1988; McBeth et al, 2001c).

The symptom of widespread pain may reflect underlying organic disease. However, studies on patients with fibromyalgia find an organic basis for symptoms in only a very small proportion of subjects. The symptom may nevertheless be a marker for poor general health including, for example, high levels of psychological distress. Alternatively, it may be a consequence of an underlying physical process giving rise to heightened pain perception. Under any of these aforementioned hypotheses, the report of widespread pain could be associated with subsequent increased mortality. We wished to test in an unselected population, the hypothesis that widespread body pain was associated on long-term follow-up with increased mortality, and if so, to determine the nature and extent of this excess.

Methods

The design was a population-based prospective cohort study. Subjects were those who had participated in two population surveys conducted in North-West England between 1991-92.

Study A was conducted during 1992 in a residential area of the city of Manchester, study B was conducted during 1991 in two areas - a commuting suburb of the city and a former mill-town in a semi-rural area of North Cheshire. Together these areas provide a mix of socio-economic conditions. They were conducted using very similar protocols. The sampling frame in each study were the age-sex registers of two local general practices. From both registers used in study A, a simple random sample of subjects aged 18-75 years was drawn, while from both registers used in study B an age-stratified random sample of subjects aged 18-85 years was drawn. A self-complete postal questionnaire was mailed to all selected subjects (with follow-up reminders to non-responders) in both studies inviting them to participate in a health survey. The studies primarily related to pain and gathered information on potential aetiological factors. Together, the studies involved a total of 6569 subjects, with participation rates in Studies A and B of 59% and 75% respectively.

In both studies, participants were asked "*During the past month, have you experienced pain lasting at least one day?*" If subjects responded positively they were invited to indicate the site(s) of pain on blank body manikins. This allowed subjects to be classified into three groups: widespread pain, regional pain and no pain. Widespread pain was defined according to the American College of Rheumatology (ACR) criteria for fibromyalgia: this requires axial skeleton pain in addition to pain in two contra-lateral body quadrants (Wolfe et al, 1990). Subjects who reported pain but who did not meet this definition were classified as having regional pain. In addition Study A, which contributed 65% of all study subjects, collected information on current smoking status and on levels of psychological distress. The latter was measured using the 12-item General Health Questionnaire (GHQ), an instrument widely used in population studies and validated as a screening tool for mental disorder (Goldberg and Williams, 1988).

Details of subjects were sent to the Office for National Statistics (ONS) to be identified on the National Health Service (NHS) Central Register. All subjects were identified on the register and their vital status determined. If the subject was registered as having died, the ONS provided information on the date and underlying cause of death coded according to the 9th revision of the International Classification of Diseases (ICD-9)(WHO, 1977). In reporting results, information on deaths up to and including 30th September 1999 – approximately 8 years of follow-up – were included.

The study gained approval from the ONS and from the ethical committee of the University of Manchester.

Statistical Analysis

The person-years at risk (of dying) was calculated for each study subject: from the date of the original survey until the 30th September 1999, or if dead, until the date of death. This allowed the mortality rate in each of the three pain groups (widespread pain, regional pain, no pain) to be determined. Thereafter Cox proportional hazards modelling was used to take account of the possible confounding effects of age (in five year age-groups), gender and study location. The results are presented, with the "no pain" group as reference, as Mortality Rate Ratios with 95% confidence intervals. Similar analyses were conducted according to specific causes of death.

Results

Of the 6569 study subjects, at baseline 15% (n=1005) were classified as having widespread pain, 48% (n=3176) regional pain and 36% (n=2388) no pain. Subjects with widespread pain (median age 55 years; 66% female) were older and more likely to be female than those with regional pain (median age 49 years; 59% female) and no pain (median age 42 years; 54% female). In total there were 654 deaths amongst study subjects during the follow-up period. The mortality rate was lowest in subjects who originally reported no pain (10.1 per 1000 person-years (py)) and increased across regional pain (13.1/1000 py) and widespread pain (16.2/1000 py) groups. The mortality rates in both the regional pain (MRR 1.21 95% CI (1.01,1.44)) and widespread pain groups (MRR 1.31 95% CI (1.05,1.65) remained significantly elevated after adjustment for age-group, gender and study location (Table 28).

The majority of the deaths in the study cohort were due to cardiovascular disease (40%), cancer (31%) or respiratory disease (16%), with only 11% due to all other disease-related causes. In addition there was a small percentage of deaths (2%) due to external causes i.e. violence, accidents and suicide. Subjects with regional pain and widespread pain were, respectively, three times and five times more likely to die from an external cause during the follow-up period (Table 29). However the wide confidence intervals around the MRR estimates are indicative of the small number of deaths from this cause. There was no relationship between pain status reported on the original survey and subsequent mortality from either cardiovascular or respiratory disease (Table 29). The excess risk was almost all due to deaths from cancer. After adjustment for age-group and gender, subjects with regional pain (MRR 1.55, 95% CI (1.09,2.19)) and widespread pain (MRR 2.07, 95% CI (1.37,3.13)) were significantly more likely to die from cancer during the follow-up period in comparison to those with no pain.

It is possible that widespread pain is evidence of cancer, particularly if metastasis throughout the body is present. For this reason we subsequently, using the NHS Central Register, identified all subjects in our studies who had been diagnosed with cancer prior to the time of completing the original study questionnaire. In total, 236 subjects were identified as having been diagnosed with cancer and were removed from subsequent analyses. However, the risk of cancer death amongst subjects with regional pain (MRR 1.66, 95% CI (1.13, 2.43)) and widespread pain (MRR 2.27, 95% CI (1.46, 3.54)) was not only maintained but slightly increased (Table 30).

Such an observation may arise as a result of a confounding factor. Therefore, using data from study A, the analysis between pain status and subsequent cancer death was further adjusted for current smoking status and level of psychological distress However the doubling in risk of cancer death associated with widespread pain was maintained (Table 31).

The three most common causes of cancer death in the study, accounting for more than half the total, were lung cancer, cancers of the gastrointestinal tract (upper and lower) and cancer of the female breast. A separate analysis of these cancers in relation to widespread pain is shown in Table 32. Although these site-specific analyses have large confidence intervals, they are suggestive of a general rather than site-specific excess cancer risks amongst subjects reporting widespread pain.

Discussion

This study has shown that subjects who reported widespread pain in two population surveys had increased mortality – principally cancer mortality - over the subsequent 8 years.

There are a number of methodological aspects to be considered in interpreting these results:

- The two population-based studies involved were conducted according to very similar protocols and the results with respect to the relationship between widespread pain and mortality (Study A 1.24 (0.91,1.69); Study B 1.41 (1.01, 1.97)) and specifically cancer mortality (Study A 1.93 (1.14,3.25); Study B 2.07 (1.08, 3.94)) are consistent.

- There were no selection factors involving the subjects apart from their decision on whether to take part in the original pain surveys. The prevalence of regional and widespread pain in these surveys is very similar to those reported by other population surveys (Wolfe et al, 1995; Andersson et al, 1993; Hunt et al, 1999). A comparison between the causes of death in the study population and mortality amongst adults aged 18-84 years in England and Wales during 1998 also shows these to be very similar:

cancer (30.7% v. 30.5% respectively), circulatory (39.9% v. 40.4%), respiratory (16.2% v. 13.5%), external (2.1% v. 3.5%), other causes (11.0 v. 12.1%) (National Statistics, 1998). It is highly improbable that those who chose not to take part would exhibit a different relationship between their original pain status and mortality over the subsequent 8 year period.

- Pain was reported at a single point in time (referring to the preceding month). In study B information was available on the duration of pain reported, and of those with widespread pain, 83% satisfied the International Association for the Study of Pain (IASP) definition of "chronic pain". So in the majority of subjects with widespread pain, these were not transient symptoms. Nevertheless, some subjects will have been misclassified according to their usual pain state, and others will have changed pain state during follow-up. Such misclassification however will result in an underestimate of the strength of the association.

- Errors in vital status on the NHS Central Register are very rare. The effect of any error in coding of cause of death would be random across pain groups. It is inconceivable to imagine that responses to a postal survey up to 10 years previously could influence the chance of an error on cause of death being made on one's death certificate. Such errors will again result in an underestimate of the strength of the association.

The absence of any previous large-scale population study, examining pain status with future cause-specific mortality, meant that we did not have an *a priori* hypothesis that excess mortality in subjects with widespread pain would principally be related to cancer deaths. Are there artefactual reasons which could have led us to observe such a relationship? Subjects who reported widespread pain differed in a number of respects from those who reported no pain. They were older and a greater proportion were female, but the excess mortality was still evident after adjustment for age and gender. The observed relationship may be due to confounding factors. Smoking is one of the most important risk factors for cancer death and it is also more common amongst subjects with widespread pain. Similarly psychological distress has been reported to be a predictor of future death from cancer (Shekelle et al, 1981) and is common amongst subjects with widespread pain (McBeth et al, 2001a). However even after adjustment for these additional factors an approximate doubling of risk of cancer death amongst subjects with widespread pain was still observed. Although we lacked information on other potential confounders, the observation that the increased cancer mortality risk may be consistent across cancer site makes identification of a "missing" confounding variable(s) difficult.

Social class is a marker for risk of dying from cancer. Is reported pain status also a measure of social class - thus explaining the association? Studies in different countries amongst populations of widely differing social status, have shown remarkably similar rates of reported regional and widespread pain (Walsh et al, 1992; Croft et al, 1993; Wolfe et al, 1995; Andersson et al, 1993; Hunt et al, 1999). Overall there is little evidence that pain reporting, particularly widespread pain, varies by social class. Specifically, a previous report from Study A has demonstrated neither a strong nor statistically significant link between reporting of back pain – the most common regional pain syndrome – and a job derived measure of social status (Papageorgiou et al, 1997 – Paper B). Although there were differences in social status between the areas in which the studies were conducted, adjustment for study area has been made in the analysis. Within each study, because the study population was sampled from persons registered with selected general practice, the variation in measures of social status (particularly if based on area of residence) would be small.

If the association is true, what are the possible mechanisms? The association may be with cancer occurrence or survival, and the precise nature of any relationship is necessarily speculative. Mechanisms associated with increased pain perception may also be associated with an increased cancer risk. Secondly, patients who reported widespread pain may have worse survival when they develop cancer. High levels of psychological distress, a feature of widespread pain, and in particular depression have been associated with reduced survival from cancer (Spiegel, 1996; Spiegel et al, 1998). However in the current study excess mortality from cancer was evident both in those with low and high levels of distress (data not shown). Some studies have provided evidence that certain psychosocial factors may predispose to the development of cancer: these include the inability to release emotion, the experience of stressful life events, psychosexual disturbance, and parental problems or separation in early life (Cox and Mackay, 1982). Many of these factors have also been linked to widespread body pain (Boisset-Pioro et al, 1995; McBeth et al, 1997). Lifestyle factors subsequent to these adverse events, possibly in combination with changes in neuro-endocrine function may result in both an increased reporting of pain and an increased risk of cancer.

In summary, this study has shown a relationship between the report of widespread pain and an excess mortality from cancer in the medium and long-term. This has implications for the long-term follow-up of patients with "unexplained" widespread pain symptoms, such as those with the fibromyalgia syndrome. However it is important to set the risk in context: the vast majority of such subjects did not die of cancer. The risk increased from approximately 1/50 amongst subjects reporting no pain to 1/20 amongst those with widespread pain. Future studies will require to confirm this association and if so, to investigate the possible mechanisms linking them.

CHAPTER 4:

METHODOLOGICAL ASPECTS OF THE EPIDEMIOLOGICAL STUDIES CONDUCTED

4.1 Introduction

In contrast to other chapters of the thesis, Chapter 4 is concerned with methodological aspects relating to the epidemiological study of pain.

Recent studies of fibromyalgia/chronic widespread pain in the population have mainly used the definition proposed by the American College of Rheumatology (Wolfe et al, 1990). This has the advantage of increasing comparability between these studies and has lead to an increase of our understanding of these symptoms. Nevertheless, there are problems associated with the definition of chronic widespread pain proposed, which are detailed in Paper J, and this paper proposes and tests a new definition. The descriptive epidemiology of chronic widespread pain, using this definition, has been described in subsequent work (not included in this thesis) (Hunt et al, 1999).

The introduction to this thesis outlined the necessity for studying the epidemiology of pain syndromes in unselected population samples – the study of subjects in care settings would be unable to distinguish factors associated with the onset of symptoms from those which predicted consultation. This is particularly true of psychological factors. Adverse psychological factors as a co-morbidity of any reported symptoms is more likely to result in consultation with that symptom. Is the relationship between fibromyalgia/chronic widespread pain and adverse psychological factors in specialist care settings simply a reflection that those with similar symptoms but without adverse psychological factors don't (or are less likely to) consult? Having studied the epidemiology of chronic widespread pain in the population, it is then feasible to study, amongst this group, what factors are associated with consultation. Such studies can then allow us to interpret studies conducted in care settings. Paper K examines the factors associated with health-care seeking amongst subjects in the community with chronic widespread pain.

While this section brings together two papers concerned with methodology they have, necessarily, been taken out of chronological order, with respect to some of the other papers. Thus Paper J uses data from the cross-sectional phase of the North Cheshire Pain Study when data on the prospective phase has previously been presented in Paper G. Similarly Paper K in this section, uses data from the baseline phase of the Altrincham Pain Study, when data on the prospective phase has previously been presented in Paper E.

4.2 PAPER J

Widespread Pain:
Is an improved classification possible?

Published Article Authors:

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Published Article Reference:
Journal of Rheumatology 1996;**23**:1628-32

Abstract

Objective: The classification of widespread pain, proposed by the American College of Rheumatology (ACR) for use in the clinic as a screen for fibromyalgia, as described, does not require truly widespread pain. Studies considering the epidemiology of widespread pain *per se* may therefore require a definition with greater face validity, which might also show enhanced associations with other physical and psychological measures. We aimed to develop a more coherent definition of widespread pain for use in epidemiological studies and to compare performance in identifying individuals with significant morbidity.

Methods: A group of 172 subjects who had participated in a community-based study on the occurrence of pain were identified and categorised by their pain experience as indicated on line drawings of the body according to the American College of Rheumatology definition and to a new, more stringent definition that required the presence of more diffuse limb pain. A number of other clinical and psychological measures were recorded for these individuals and the association between their pain status measures and these other variables was assessed and compared.

Results: Persons satisfying the newly-proposed definition for chronic widespread pain, in comparison with those who satisfied only the present American College of Rheumatology definition, had a significantly higher score on the General Health Questionnaire [median difference (MD) 7, 95% CI 1,13], a higher score on the Health and Fatigue Questionnaire [MD 10, 95% CI 0,15], and greater problems with sleep [sleep problem score MD 4, 95% CI 0,9]. Those satisfying the new definition also had a greater number of tender points on examination [MD 3, 95% CI 1,7]. The morbidity of those satisfying only the present American College of Rheumatology definition was closer to persons who had regional pain.

Conclusion: A redefinition of widespread pain has produced a group of subjects whose pain is (a) likely to be more "widespread" and (b) is associated more strongly with factors

such as psychological disturbance, fatigue, sleep problems, and tender points, and may be more appropriate in epidemiological studies.

Introduction

Classification criteria for the diagnosis of fibromyalgia have been established by the American College of Rheumatology (ACR) (Wolfe et al, 1990). According to recommendations, a diagnosis is made when both the following are present: (a) chronic widespread pain, i.e. pain in the axial skeleton and two contralateral quadrants for at least 3 months, and (b) 11 or more of 18 designated points on the body reported as painful on applied pressure of about 4kg (tender points). The 18 areas were chosen because they provide good discrimination between patients with and without a physician diagnosis of fibromyalgia, and many represent sites of regional soft tissue syndromes.

Population studies have reported the occurrence of chronic widespread pain have shown the symptom to be relatively common (Forseth and Gran, 1992; Raspe and Baumgartner, 1992; Lyddel and Myers, 1992; Croft et al, 1993; Wolfe et al, 1995). Direct comparison is difficult, however, since not all studies have used the definition of chronic widespread pain from the American College of Rheumatology criteria for fibromyalgia, but generally studies have revealed that, even in the community, widespread pain is related to the presence of other physical and psychological symptoms and tender points (Croft et al, 1994; Hawley et al, 1998; Kirmayer et al, 1988; Jennum et al, 1993; Magni et al, 1994; Wolfe et al, 1997). However the definition of widespread pain in the American College of Rheumatology report has been suggested as too broad (Schochat et al, 1994) for population studies, allowing persons whose pain is not widespread e.g. with back pain plus pain in one small joint of the right hand and of the left foot to be classified as having chronic widespread pain. It is therefore appropriate to evaluate whether a more focused definition of chronic widespread pain may be more suitable for use in population studies.

We propose a definition of chronic widespread pain for use in epidemiological studies, to ensure those satisfying the definition have pain that may reasonably be considered widespread. We also consider whether this new definition has construct validity, by examining whether it is more strongly related to the physical and psychological factors noted to occur with chronic widespread pain as currently defined.

Materials and Methods

We used data from an epidemiological survey conducted among the registered population of two general practices in Cheshire, United Kingdom. In total, 1340 subjects (75% of those who received an invitation to participate) between the ages of 18 and 65 years completed a postal questionnaire that inquired about any pain experienced during the previous month that had lasted longer than 24 hours. From the original survey responders, a sample of 250, stratified by pain status in 3 groups according to the American College of Rheumatology definition (no pain, regional pain, chronic widespread pain) were requested to agree to examination for tender points by a research nurse, again according to the criteria of the American College of Rheumatology (Wolfe et al, 1990). They also completed a questionnaire that included items on pain assessment, sleep problems (Jenkins et al, 1988), the General Health Questionnaire – 12 item version (Goldberg and Williams, 1988), and the Fatigue Questionnaire (Chalder et al, 1993). Both the General Health Questionnaire and the Fatigue Questionnaire were self-administered by the subjects after the interview and examination. The sleep problem questions were administered by the interviewer. This 2nd phase was carried out up to 12 months after the first survey, and respondents with data available from the 2nd phase (172 subjects; 69% participation rate) are the subjects used for the current analysis.

As part of the assessment of pain, subjects were requested to indicate on line drawings of the body (front, back, left and right sides) the location of any pain lasting at least 24 hours during the previous month. The information on pain provided on these line drawings has been recorded using the American College of Rheumatology defined regions and in an alternative way ("Manchester definition). The section used for the Manchester definition of widespread pain are shown in Figure 5; each individual section has been coded as positive (if any part of the area has been indicated as painful during the past month) or negative (otherwise). In this recording scheme each limb consists of 4 sections, and pain is considered to be present in a limb if there are at least 2 painful sections. Pain is not considered to be present in a limb if only one section is indicated with pain. "Widespread pain" is defined as axial skeleton pain (including low back) and pain in contralateral limbs (i.e. left arm/right leg or right arm/left leg). The section of anterior and posterior chest, sternum and abdomen are infrequent sites for musculoskeletal pain and have been omitted from the definition.

All 172 subjects were therefore divided into those who (1) satisfy the Manchester definition for chronic widespread pain, (2) satisfy the American College of Rheumatology definition of chronic widespread pain but not the Manchester definition ("ACR only group") (3) have pain but satisfy neither the Manchester nor American College of Rheumatology criteria (regional pain, RP) (4) those with no pain (NP).

The distribution of scores recorded by each of these 4 groups on the General Health Questionnaire (a validated screening tool for possible clinical depression), the Fatigue Questionnaire, the sleep problem scale, and with respect to the number of tender points present was compared using the non-parametric Kruskal-Wallis test (Kruskal and Wallis, 1952). Confidence Intervals (CI) for the median difference in scores have been calculated by the Wilcoxon-Mann-Whitney method (Pearson and Hatley, 1972; Sprent, 1993). Statistical analyses have been conducted using STATA (StataCorp., 1993).

Results

Of 172 selected subjects responding to the 2nd phase of the epidemiological survey, 38 reported no pain, 92 regional pain, and 42 chronic widespread pain (ACR definition) when visited by a research nurse. The median age of all subjects was 53 years (range 20-75) and 33% were male, with no significant difference between pain groups. The most common areas for pain among those with regional pain were shoulder/upper arm, hand/wrist, lower back/axial skeleton, and the knee or above on the lower limb. Pain in each of these areas was reported in 20-33% of subjects. Pain below the knee, in the skull region, elbow/lower arm, and abdomen was less common (<15% positive responses), while pain over the neck or anterior/posterior chest wall was rare (<5% positive responses) (Figure 5). A similar distribution of painful sites (although at a higher level of positive response) was noted in subjects with chronic widespread pain, ranging from a 10-12% positive response rate for the anterior chest wall to 61% for the shoulder/upper arm. By definition, pain in the axial skeleton or lower back is always reported in such subjects. Of the 42 subjects with widespread pain, 11 satisfied the more stringent Manchester definition and the remaining 31 only the American College of Rheumatology definition.

The duration of pain did not differ significantly between the 2 groups with chronic widespread pain although the median duration was higher for the Manchester group (>10 years) than the ACR only group (9 years). Persons satisfying the new definition, however, had higher scores on the General Health Questionnaire [median difference(MD) 7, 95% CI 1,13], a higher score on the Fatigue Questionnaire [MD 10, 95% CI 0,15] and greater problems with sleep [sleep problem score MD 4, 95% CI 0,9]. Those satisfying the new definition also had a greater number of tender points on examination [MD 3, 95% CI –1,7] (Figures 6a-d).

It is of further interest to determine whether those whose pain is not truly widespread but who meet the current American College of Rheumatology definition ("ACR only" group) experience different morbidity from those with regional pain. Persons with regional pain had a significantly shorter reported duration of pain (4 vs. 9 years, $p<0.02$), but there is clearly no difference between the 2 groups with respect to scores from the Health and Fatigue Questionnaire and General Health Questionnaire (Figures 6a and b). In contrast, the median scores on the sleep problem scale rise progressively across the No pain, Regional pain, ACR only, and Manchester groups (Figure 6c).

Discussion

Pain is central to the definition of fibromyalgia, and the concept of widespread pain has formed part of many, but not all (Smythe and Moldofsky, 1977) definitions of the disease. When the American College of Rheumatology considered criteria for the diagnosis of fibromyalgia (Wolfe et al, 1990), 98% of patients considered clinically to have fibromyalgia experienced widespread pain (i.e. axial skeleton pain in addition to pain above and below the waist, on the right and left side of the body). There is, however, no set pattern of sites from which this pain is reported to arise. Pain can arise in almost all muscles or only some muscles; pain is also commonly reported from the axial skeleton and/or joints, and is common at sites other than those of the musculoskeletal system, such as the abdomen and bladder. Nevertheless, although subjects with fibromyalgia almost always have widespread pain, 71% of control subjects with other musculoskeletal diseases (including local/regional pain disorders) also had widespread pain (Wolfe et al, 1990). In addition, among all patients satisfying the definition of widespread pain, only about two-thirds complained of "pain all over". Therefore, while the American College of Rheumatology definition is useful as part of a simple 2-step screen for fibromyalgia, when used alone in epidemiological studies, it would need to exclude all but those whose pain may reasonably be considered widespread.

The 172 subjects studied here represent a group drawn from a population survey. Although selection biases may be present, the response rate in the study was high, and the participation rate among those chosen for examination by a research nurse was similarly high across pain classification groups. It is therefore likely that participants are representative of the population from which they have been selected. Although 172 subjects is a fairly large group, it is insufficient to enable a comparison between several alternative definitions of widespread pain. Since the number of subjects satisfying the current definition for widespread pain is 42, the number in any new group formed would be lower. Small differences in definition are likely to result in only a few subjects changing category, thus making comparisons of little use. We therefore decided in advance to choose one alternative definition and to compare those meeting this definition with those only meeting the current standard, and those with regional pain.

Any definition chosen is arbitrary; however we used what might be considered reasonably to reflect the term "widespread", based on the number and distribution of painful area. It is a simple extension from the current definition, each limb being divided into 4 sections, pain must be present in at least 2 of 4 sections to be considered present in the limb. This requires pain to be more diffuse than previously; pain in only one section of a limb is not sufficient. The areas of the abdomen, anterior/posterior chest and neck/sternum are no longer considered; however, since in our experience these areas are infrequently identified, this makes little practical difference to the definition. The requirements for axial pain, pain above and below the waist, and on the left and right side is retained.

Despite the small number of subjects noted above, there were differences between the group satisfying the new and those satisfying the current definition. The difference was statistically significant in subject scores for the General Health Questionnaire, and marginally significant for the Fatigue Questionnaire and sleep problem score. Subjects satisfying the new definition also had a higher number of tender points. All these factors have been shown to be associated with chronic widespread pain. Further, the group who no longer met the definition for chronic widespread pain did not differ in important "covariates", such as score on the General Health Questionnaire and Fatigue Questionnaire from persons with regional pain.

This would suggest that the groups formed (RP, ACR only and Manchester) represent groupings at different points on the continuous distribution of subjects from those with no pain to those with pain in all parts of the body. The division into groupings, while artificial, allows the epidemiology of symptoms to be studied. The utility of such groupings will also depend on whether the differences observed are related to important measures such as natural history of the condition and likely outcome.

In summary, chronic widespread pain has been shown to be a common condition in the community, associated with other symptoms such as depression, sleep disturbance, and tender points throughout the body; its presence is one of two necessary criteria for the "diagnosis" of fibromyalgia. Our study has shown, however, that a more stringent definition of such symptoms may be warranted for use in epidemiological studies of widespread pain. A reclassification such as suggested above, could, in addition, identify persons with more severe clusters of symptoms, which may be related to the natural history and prognosis of the condition.

4.3 Paper K

Chronic widespread pain in the community:

the influence of psychological symptoms and mental disorder on health-care seeking behaviour

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Published Article Reference:

Journal of Rheumatology 1999;**26**:413-9

Abstract

Objectives: To determine whether psychological symptoms and mental disorder are an intrinsic part of the chronic widespread pain syndrome or whether they have been observed in clinic attenders primarily because of their influence on the decision to seek a medical consultation.

Methods: A population survey of 1953 subjects was conducted in the Greater Manchester area of the United Kingdom. The survey included a postal questionnaire, and in a sub-group of respondents with high levels of distress, the presence of mental disorder was assessed by a semi-structured standardised interview. Subjects with chronic widespread pain were classified according to whether they had sought a medical consultation for the reported pain ("consulters") or not ("non-consulters").

Results: 252 subjects (13%) satisfied ACR criteria for chronic widespread pain, and of those 72% reported having consulted a general practitioner about this pain. There was a clear difference in levels of psychological distress, between consulters, non-consulters and those with no pain. Consulters did not differ from non-consulters in terms of levels of fatigue, social dysfunction nor the number of somatic symptoms reported. Although consulters (amongst whom 1 in 4 had a mental disorder), were more likely to have a mental disorder than subjects without pain (OR=4.9 95% CI (2.6,9.5)) the increase in risk comparing consulters to non-consulters (OR=2.1, 95% CI (0.7,5.9)) and non-consulters to subjects without pain (OR=1.4, 95%CI (0.7, 2.6)) was not significant.

Conclusion: The results suggest that psychological distress is associated with chronic widespread pain in addition to any effect on whether consultation is sought for symptoms. The finding that one-quarter of consulters to primary care with chronic widespread pain

have a mental disorder should alert primary care physicians and rheumatologists to screen for mental disorder in this group.

Introduction

Chronic widespread pain is a commonly reported symptom, with an estimated prevalence of 11% amongst populations in England and Wales, and the United States (Croft et al, 1993; Wolfe et al, 1995). Many of those with chronic widespread pain seek health care for symptoms, resulting in this being one of the most common conditions seen in rheumatology clinics (Wolfe, 1994). It is perceived as difficult to treat with improvement of symptoms rarely occurring. In addition to widespread pain symptoms, subjects may have high levels of 'psychological distress' (specifically mood and anxiety disorders) and other somatic symptoms such as numbness and paraesthesia, constipation or diarrhoea, tiredness, sleep problems and tenderness to palpation (Croft et al, 1993; Wolfe et al, 1995; Yunus et al, 1989; Goldenberg, 1994).

The relationship between chronic pain and mental disorders, particularly depressive disorders, has been shown to be complex. Whereas it might be assumed that psychological distress generally results from physical symptoms and is related to the severity of underlying organic disease, excess psychiatric morbidity is strongly associated with both medically explained and medically unexplained physical complaints (Kisely et al, 1997). Recent longitudinal studies are inconclusive but suggest that depression can both precede the onset of chronic pain and can develop subsequently, so that the direction of any causal relationship remains uncertain (Magni et al, 1994; Skevington, 1994).

Not all subjects with chronic widespread pain seek consultation and it has been suggested that co-morbid psychological distress is not a common feature in such "non-consulters" (Aaron et al, 1996). Certainly, high levels of psychological distress amongst subjects with chronic widespread pain have been related to a poor outcome, and when considered overall, community subjects appear to have a more favourable outcome than patients attending clinic (Macfarlane et al, 1996a – Paper G). In general, the likelihood of seeking a medical consultation with symptoms is known to be influenced by the perceived seriousness of physical symptoms, psychosocial factors (such as abnormal illness behaviour) and the presence of psychiatric illness (Craig and Boardman, 1990). Since somatic symptoms are prominent in mood and anxiety disorders it is thought that these common psychiatric disorders influence medical utilisation primarily through bodily complaints. High levels of psychological symptoms and mental disorder may therefore be observed in those who seek health care with chronic widespread pain primarily because they increase the likelihood that a subject with symptoms will seek a medical consultation. Alternatively, psychological symptoms and mental disorder may be intrinsic features of the condition, and be present whether or not a subject seeks consultation.

We test the hypothesis, in a population-based study, that psychological symptoms and mental disorder are not an intrinsic part of the chronic widespread pain syndrome but have been observed in clinic attenders primarily because of their influence on the decision to seek a medical consultation. Amongst subjects with chronic widespread pain, the study compares consulters and non-consulters with respect to scales of psychological distress, fatigue, social dysfunction, somatic symptoms, illness attitude and the presence of mental disorder, and in a sub-group of subjects with psychological distress, comparisons are made regarding tenderness on examination.

Materials and Methods

Subjects

The design was a cross-sectional population survey involving a postal questionnaire (previously described in Paper E) and face-to-face interview. Briefly, the sampling frame was the adult population aged 18-65 years who were registered to receive treatment care at a general practice in the Greater Manchester area of the United Kingdom (n=3602). The area served by the study practice is a commuting suburb of Manchester city; it is of mixed sociodemographic composition, but relatively affluent in comparison to the region as a whole.

Survey Method

Each of 3004 subjects, selected by simple random sampling, received a mailed questionnaire, with non-responders receiving a postcard reminder after 2 weeks and, if necessary, a second mailed questionnaire after a further 2 weeks. Information was obtained on whether pain (lasting at least 24 hours) had been experienced during the past month. Subsequent questions established the duration of pain and whether subjects had sought a medical consultation with their general practitioner for the reported symptoms. The general practitioner represents the first point of contact for persons with symptoms in almost all cases. The site of any pain reported was indicated by shading on a body manikin. From these responses, it was determined whether subjects satisfied the definition of chronic widespread pain, used in the classification criteria for fibromyalgia proposed by the American College of Rheumatology (ACR) (Wolfe et al, 1990), which requires at least axial pain and contra-lateral limb pain lasting for more than three months. In addition, it was determined whether subjects satisfied more stringent criteria (specifically requiring more diffuse limb pain) proposed for chronic widespread pain ('Manchester' criteria) (Macfarlane et al, 1996b – Paper J).

An additional 5 sub-sections of the questionnaire were chosen to assess the probability of mental disorder and psychological distress, and to assess aspects of physical complaints, attitudes and behaviours which have been associated with somatic presentations of mental disorders (Ciccone et al, 1996; Fink, 1996). Four of these instruments (i-iv) have been described previously in Paper E, but are reproduced here for completeness:

i *The General Health Questionnaire (GHQ)-* 12-item version (Goldberg and Williams, 1988) was developed as a screening instrument for mental disorder in the general population and has been widely used as a measure of psychological distress. Item responses are scored 0 or 1, resulting in a total score of 0-12. Validation studies compared GHQ scores with 'case' identification using standardised semi-structured psychiatric interviews and indicate how GHQ threshold scores can be varied according to the purpose of screening. In the present study we have chosen a low threshold of >=2 in order to achieve high sensitivity at the expense of specificity. This allows the assumption that those who are 'screen negative' (i.e. with a GHQ score of 0 or 1) are extremely unlikely to have a mental disorder.

ii *The Somatic Symptom Scale* was originally validated as a screening test for somatisation disorder (Othmer and DeSouza, 1985), as defined by World Health Organisation criteria (WHO, 1991). It enquires about the life-time experience of 6 symptoms in men and 7 in women. A threshold of 3/4 resulted in sensitivity of 73% and specificity of 94%. Less than 0.1% of the general population meet the full WHO criteria for somatisation disorder but over 4% meet less stringent criteria (Escobar et al, 1987). The Somatic Symptom Scale was included in the present study as a brief measure of the propensity to present somatic complaints. One item from the original scale asked about pain in fingers and toes and, in order to avoid spurious associations between assessments, this was replaced with a non-pain symptom (aphonia) which was identified in the original validation study as the next best predictor of somatisation disorder.

iii *The Fatigue Questionnaire* (Chalder et al, 1993) is an 11-item instrument developed for use in population studies to measure physical and mental aspects of fatigue. Item responses are scored 0 or 1 and summed to provide a total score of 0-11, with high scores corresponding to high levels of fatigue. This assessment has been validated in primary care samples by comparison with a structured clinical assessment (Chalder et al, 1993) and data are available from a large population based survey (Pawlikowska et al, 1994).

iv *The* nine *Illness Attitude Scales* (Kellner et al, 1987) assess illness related concerns and behaviours. Each scale consists of three items scored from 0-4, with a total score 0-12. Individual scales assess, for example, Worry about Health, Concern about Pain, Hypochondriacal Beliefs, Effect of Symptoms and Treatment Experience. Each of these scales, with one exception (Health Habits) has been shown to discriminate between patients diagnosed with hypochondriasis (as defined by the third revised edition of the Diagnostic and Statistical Manual) (APA, 1980), other psychiatric patients, primary care patients and non-consulters (Kellner et al, 1987).

v *The Self Care Assessment Schedule* (Barnes and Benjamin, 1987) assess the frequency of self-care related behaviours during the preceding two weeks. There are ten items, each scored from 0-4, resulting in total scores of 0-40, with high scores indicating greater restriction. This assessment has been shown to have good test-retest reliability, and different aspects of validity have been studied extensively (Benjamin and Barnes, 1987). Results are closely related to those of alternative measures of disability and it provides good discrimination between groups of patients (including pain clinic patients) and non-consulters, across the range of clinically significant disability. It is suitable as a measure of disability in population surveys as it is brief and readily acceptable.

Interviews

Resources precluded interviewing all subjects who were classified as "screen positive" for mental disorder (a score of ≥ 2 on the GHQ), and therefore a sample (80% of the total) was chosen, by simple random sampling, and these subjects were requested to participate in the second stage interview and examination. The interview, conducted by a psychiatrist, included one of the instruments (the Present State Examination (PSE)) within the Schedules for Clinical Assessment in Neuropsychiatry (SCAN). The PSE is a semi-structured standardised interview which assesses the presence of mental disorder (Wing et al, 1990) . All diagnoses fulfilled ICD-10 criteria (WHO, 1992).

In addition, interviewed subjects underwent a systematic examination for tenderness, conducted by one of two research nurses, according to ACR guidelines (Wolfe et al, 1990). Manual pressure of 4 kg was applied with the thumb, in turn, at 18 points. Definite tenderness at any of the points was considered to be present if some involuntary verbal or facial expression of pain occurred or a wince or withdrawal was observed. The total number of tender points was recorded. Prior to and during the study, training sessions were held for the research nurses, including the use of a dolorimeter to determine the pressure applied, and these consistently showed high levels on inter- and intra- observer reliability.

Statistical Analysis

Subjects have been classified into three groups: 1) subjects with chronic widespread pain who have sought a medical consultation regarding pain symptoms, 2) subjects with chronic widespread pain who have not sought a medical consultation regarding pain symptoms, 3) subjects classified as having no pain. Subjects who reported pain, but did not satisfy criteria for chronic widespread pain will not be considered in this report.

The analysis aimed to identify factors associated with consultation for chronic widespread pain. The distribution of scores on the above instruments was compared (pairwise) between the three groups using the Mann-Whitney U test (MW): the distributions being mainly non-Gaussian. For scales of psychological distress, fatigue, disability, and somatic symptoms, and Illness Attitude scales in which a difference in score distribution was observed between chronic widespread pain consulters and non-consulters, subjects have been divided into two groups (using the median score of the individual scale amongst those with chronic widespread pain). For each measure, the odds of consulters recording a score above the median was calculated relative to non-consulters. The odds ratios were calculated using logistic regression, are adjusted for age-group (18-32, 33-42, 43-52 and

53-65 years), and are shown separately by sex. As not all persons with a high GHQ score were interviewed a weighted analysis was undertaken in assessing the relationship between pain and mental disorder to reflect the interviewed/not-interviewed ratio. The use of a weighted analysis will result in the width of the calculated confidence intervals reflecting the fact that not all subjects were interviewed. Additionally, on the basis of the observed association between GHQ score and mental disorder observed in the interview group, the prevalence of mental disorder amongst consulters and non-consulters was calculated in those eligible but who were not interviewed, and assuming that all consulters/non-consulters who were screen "negative" for mental disorder (scoring 0 or 1 on the GHQ) did not have a mental disorder.

All statistical analyses were calculated using STATA (StataCorp., 1993).

Results

From the 3,004 subjects mailed a study questionnaire, 1953 (835 males, 1118 females) completed responses were received. Of the non-responders, analysis of the electoral records revealed that 402 were not currently registered at the address recorded on the General Practice records (so called 'ghost patients') and therefore did not receive a questionnaire. The overall participation rate amongst persons receiving a questionnaire was therefore 75%, with, higher participation rates amongst females at all ages (Table 33).

The ACR criteria for chronic widespread pain were satisfied by 252 subjects (13%; 10.5% males, 14.7% females). Of those with chronic widespread pain, 72% reported having consulted a general practitioner regarding the pain, with females only slightly more likely to have consulted with symptoms than males. The likelihood of consulting with symptoms increased with older age amongst females (χ^2 test for trend - $p<0.01$): in males, the highest rates were in the youngest (18-32 years) and oldest (53-65 years) age-groups (χ^2 test for trend - $p= 0.20$) (Table 34). Subsequent analyses on factors affecting the likelihood of consultation with chronic widespread pain are adjusted for both age-group and sex. In comparison to non-consulters, consulters with chronic widespread pain were more likely to have pain on the day of the survey (OR=2.5; 95% CI(1.3-5.0)) and to be not working due to ill-health (OR=9.8; 95% CI (2.2-43)). Amongst those with chronic widespread pain (according to the ACR criteria) there was no significant increase in the odds of consulting associated with additionally satisfying the Manchester criteria despite the fact that these criteria require genuinely more diffuse and widespread pain (Males OR=1.1 95% CI (0.4, 3.1), Females OR=1.3 95% CI (0.5,3.1)).

The cumulative distribution of scores on the GHQ, Fatigue, Self-care assessment and Somatic Symptom Scales for consulters, non-consulters and those with no pain are shown in Figure 7. There is a clear difference between each of the three groups in relation to levels of psychological disturbance as measured by the GHQ (MW tests (all pairwise comparisons): p-values < 0.03). On all of the other 3 scales, consulters recorded significantly higher scores in comparison to those with no pain (MW tests : p- values < 0.01), but did not differ in scores in comparison to non-consulters (MW tests: p-values ≥ 0.08). Non-consulters reported higher levels of fatigue and a greater number of somatic symptoms in comparison to those with no pain (MW tests: $p < 0.01$). On the Illness Attitudes Scales, with the exception of items on "Concern about Pain" and "Lifestyle/Health Habits", consulters scored significantly higher on all scales than those with no pain (MW tests: $p \leq 0.01$). There were no differences on the Illness Attitudes Scales between consulters and non-consulters except that consulters reported more "Health Seeking Behaviour/Treatment Experience" (as may be expected) and a greater "Effect of Symptoms" on activities (MW tests: $p < 0.01$) .

The odds of consulters scoring highly (above the median score) on the measured scales (in comparison to non-consulters) are shown in Figure 8, separately by sex. Amongst females, consultation was significantly associated with high levels of psychological disturbance and a greater perceived effect of symptoms on activities . In addition a relationship with high levels of social dysfunction and greater number of reported somatic symptoms is suggested although increased odds were not statistically significant. In males there were no significant associations with consultation, although consulters (in comparison to non-consulters) were more than twice as likely to report high levels of fatigue. Differences in levels of psychological distress between non-consulters and subjects with no pain previously noted, were similar in both males and females (data not shown).

A total of 710 subjects had a GHQ score ≥2 but 157 (22%) of these refused further contact. Of the remaining 553, a random sample of 369 were contacted for interview of whom 301 agreed (82%). Participants in the second-stage interview were significantly older (median age 44 v. 39 years) and had higher levels of self-care ($p < 0.01$) in comparison to those refusing further contact or interview, but otherwise participants and non-participants did not differ. Amongst the participants in this second stage (all with GHQ ≥2), information is available on tenderness (assessed by manual palpation) and the presence of mental disorder. The distribution of the number of tender points, did not differ overall between consulters (median 7: Inter-quartile range (IQR) (3-10)) and non-consulters (Median 7: IQR 2-9) (MW test: p=0.87), although all 7 subjects with 11 or more tender points (and therefore meeting ACR criteria for fibromyalgia) had consulted their general practitioner.

In all, 97 of the 301 individuals interviewed were classified as having a mental disorder. There was an increased odds of having a mental disorder for consulters with chronic widespread pain relative to those with no pain (OR=4.9, 95% CI (2.6, 9.5)). The increased odds of a mental disorder amongst consulters in comparison to non-consulters was non-significant (OR=2.1, 95% CI (0.7, 5.9), but similar to the results seen with respect to psychological distress the suggested association was almost exclusively in females (OR=2.5, 95% CI (0.6, 10) rather than males (OR=1.3, 95% CI (0.2, 8.5). The increased odds of a mental disorder in non-consulters, in comparison to those with no pain, was smaller (OR=1.4, 95%CI (0.7, 2.6)) and non-significant. Overall, an estimated 25% of consulters with chronic widespread pain had a mental disorder in comparison to 14% of non-consulters. The diagnoses made were similar in both groups: depressive disorders were most common (consulters 44% of mental disorders; non-consulters: 57%) with phobias and other anxiety disorders also frequently diagnosed in the consulting group and present in the non-consulting group.

Discussion

Chronic widespread pain symptoms have been associated with a variety of other physical and psychological symptoms in both clinical and community studies (Croft et al, 1993; Wolfe et al, 1995). Psychological complaints include depression, fatigue and problems with sleep, while subjects have also been found to have a greater lifetime experience of psychological disorders (Goldenberg, 1994). Psychological distress is known to be related, in general, to the likelihood of seeking a medical consultation, and it has been postulated that in clinical studies of patients with chronic widespread pain, the frequency of psychological distress is due to its association with consultation behaviour rather than being an aetiological factor in the experience of symptoms. Consequently, if this were to hold, subjects with chronic widespread pain who had not sought a medical consultation would have lower levels of psychological distress than those consulting, and similar to subjects without pain.

In the current study, there were few differences observed between consulters and non-consulters. Female consulters did have higher levels of psychological distress than non-consulters while the odds of female consulters having a mental disorder (relative to non-consulters) were increased more than 2-fold (although this result did not reach statistical significance). There were no significant differences observed however between consulters and non-consulters in levels of fatigue, number of somatic symptoms nor levels of self-care reported. Non-consulters (in comparison to those without pain) did have higher levels of psychological distress, fatigue and reported more somatic symptoms.

Two previous studies have examined factors associated with consultation amongst fibromyalgia patients. Wolfe et al (1995) compared fibromyalgia patients from a variety of clinic settings with those identified in a community survey and found few differences between the two groups except that clinic patients reported increased levels of fatigue, disability, pain and overall severity. In particular there was no difference in levels of psychological disturbance between the two groups (both sexes combined) as measured by the Symptom Checklist 90 (Revised) (Derogatis and Cleary, 1977) and the Arthritis Impact Measurement Scales (AIMS) Anxiety and Depression Scales (Meenan et al, 1980) . Aaron et al (1996) studied fibromyalgia patients (presenting to a single rheumatology clinic, and without co-morbid medical conditions), comparing them to volunteer subjects in the community with fibromyalgia (who had not sought medical care) and volunteer community healthy controls. Examining both sexes combined, the study found considerable differences between patients and non-patients in the number of lifetime psychiatric diagnoses (in addition to pain intensity, tender points, pain threshold and fatigue), and differences between all three groups in current levels of anxiety and depression. The authors concluded that psychiatric disorders were not related intrinsically to fibromyalgia but that multiple lifetime psychiatric diagnoses may increase the likelihood of the subject seeking medical care. Although collecting similar information, the current study, which has found comparatively few differences between consulters and non-consulters, differs in a number of important ways from these previous studies: (1) subjects are those with chronic widespread pain, and not only those with both widespread pain and multiple tender points (fibromyalgia) (2) consulters in the present study are presenting to primary care and not to tertiary care or subspecialty clinics, and (3) this study measures *current* psychiatric disorders and psychological distress. The effect of these differences, particularly with respect to the setting in which patients are recruited, may have been that the studies of Wolfe et al (1995) and Aaron et al (1996) define a "consulting" group with more severe and persistent symptoms.

Certain psychiatric disorders, particularly the group of somatoform disorders, characteristically start in early adult life and are chronic, the onset preceding the development of episodes of chronic pain. By contrast, the majority of psychiatric diagnoses found in population studies, including this one, are mood disorders, which are generally relatively brief, but the timing of onset in relation to pain cannot be accurately determined in a cross-sectional study. Previous work suggests that psychological distress sometimes precedes pain symptoms (Magni et al, 1994). Given that we have observed differences in females in the level of psychological distress and mental disorder between consulters and non-consulters and differences in both sexes in the level of psychological distress between non-consulters and those with no pain, this suggests that distress may be an aetiological factor in the experience of pain and/or that pain contributes to distress, and that (at least in females) levels of distress are related to severity and hence consultation. There is only limited information available in this study to assess whether consulters have more severe disease (more consulters report current pain, and a greater effect of symptoms on daily activities and work) and this therefore must remain a possibility. Further, distress may be a consequence of failure to receive effective management for their condition.

Unlike clinic studies which include highly-selected groups of patients, the current study has the advantage of being population based. Over 95% of the population in the United Kingdom are registered with a general practice to which they would initially consult with symptoms. It achieved a high participation rate and the prevalence of chronic widespread pain was almost identical to that found in a previous population study (Croft et al, 1993). In addition the comparatively large numbers of persons with chronic widespread pain in this study would have allowed us to detect important differences between the two groups, if these existed, although when comparison has focussed on sub-groups such as those with/without a mental disorder or males/females the power to detect a given difference is lower. Further, the cross-sectional nature of the study has not allowed us to investigate the temporal relationship between psychological distress, symptom onset and consultation. In order to do so it will be necessary to follow subjects in this study prospectively.

What therefore are the implications of our results? The finding that overall 25% of consulters with chronic widespread pain have a mental disorder should alert General Practitioners and rheumatologists alike to screen for mental disorders in this group. In order to aid identification, a simple screening questionnaire such as the GHQ could be used. As part of a comprehensive approach to the health of patients with chronic widespread pain, including physical and social aspects, treatment for a mental disorder may be required and contribute to alleviation of symptoms (Benjamin and Main, 1995).

Chapter 5:

THE RELATIONSHIP BETWEEN REGIONAL AND WIDESPREAD PAIN SYNDROMES

5.1 Introduction

Chapters 2 and 3 of the thesis have presented manuscripts exploring the onset and outcome of regional and widespread pain syndromes. The regional pain syndromes have included those of the lower back, shoulder and forearm. The studies on widespread pain have generally used the definition of chronic widespread pain proposed in the American College of Rheumatology criteria for fibromyalgia. Until this point in the thesis these regional pain syndromes have been considered distinct entities, and as a group they have been considered distinct from widespread pain. To what extent however are regional and widespread pain syndromes truly distinct entities? Is chronic widespread pain simply pain at multiple sites, or the extreme end, with respect to time and spatial distribution, of a pain spectrum? Transferring this question from a research setting to the clinic. To what extent for example, when someone presents with low back pain should one be focussing on the lower back and to what extent should one consider the patient as having pain that happens to be in the lower back? Similarly with pain at multiple sites. To what extent should one focus on these sites individually as opposed to the patient having pain at several body sites?

The epidemiology of onset and outcome of regional and widespread pain syndromes is reviewed in Paper L to provide some insight to the above questions. It uses data from the studies previously presented in this thesis, additional data from these studies and relevant data from studies of other authors.

5.2 Paper L

Generalised pain, fibromyalgia and regional pain:

an epidemiological view

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Published Article Reference:

Baillière's Clinical Rheumatology 1999;**13**:403-14

Abstract

Regional and generalised musculoskeletal pain syndromes are common disabling symptoms in the population. Pain at individual sites, such as the lower back and shoulder, and generalised pain, which is one component of the fibromyalgia syndrome, have traditionally been considered as distinct entities and studied separately. In this chapter the evidence is examined, both in term of patterns of occurrence and known aetiology, to determine whether these really are distinct entities or, in fact, part of a spectrum ranging from no pain to chronic widespread pain. In the second part of the chapter the descriptive epidemiology of generalised pain is reviewed together with factors identified as increasing risk for the onset and persistence of symptoms.

Definition of widespread pain

Chronic widespread pain is the principal component of the syndrome known as "fibromyalgia", and is associated with other physical symptoms, psychological distress and widespread tenderness on examination. Early studies did not use consistent criteria for this syndrome and, in particular, definitions of widespread pain differed. Yunus (1989) required subjects to have pain and/or stiffness at four or more anatomic sites for 3 months or longer (with bilateral involvement counting as one site) while other studies simply required pain to be "generalised" without further specification. In 1990 the American College of Rheumatology (ACR) published classification criteria for fibromyalgia. The working group considered which factors best differentiated between subjects "diagnosed" with fibromyalgia by individual rheumatologists and an age- and sex- matched group with other painful conditions. Information collected relating to pain included, the total number of painful regions (from a list of 30 provided), the anatomical location of painful sites (recorded on a body manikin) and an assessment by patients of whether they had "pain all over". The presence of "widespread pain" defined, using information from body manikins, as axial pain and pain in at least contra-lateral body quadrants (Figure 9) was very sensitive in identifying subjects with fibromyalgia (98%) although not very specific (31%), while pain in at least 15 body regions had poor sensitivity (56%) but was very specific for patients with fibromyalgia (87%). Overall there was little difference in the accuracy of multiple regional pains (71%) or widespread pain (66%) for identifying subjects with fibromyalgia. However the optimal *combination* of factors which best identified patients with fibromyalgia was widespread pain and multiple tender points.

These ACR classification criteria for fibromyalgia gave rise to the perception that this combination of pain and tenderness defined a distinct entity. However Croft et al (1994), while confirming the link between generalised tenderness and widespread pain, showed that tenderness was also associated with other physical symptoms and psychological distress independent of pain. Further studies examining the relationship showed a trend of increasing numbers of tender points with increasing number of body regions with pain i.e.

the relationship was not confined only to those with chronic and widespread pain (Croft et al, 1996; Wolfe, 1997). This suggests that the relationship between regional pain syndromes and chronic widespread pain/fibromyalgia is one of degree and not of qualitative difference. This is discussed further, later in this paper.

Is generalised pain simply regional pain at multiple sites?

What do we mean by "generalised" pain? Do we mean pain that is felt literally all over the body, or do we mean regional pain at multiple sites? If the latter, how many sites and where does pain need to be experienced before it is considered generalised? Traditionally regional pain syndromes have been considered as distinct entities and studies conducted of individual sites such as the lower back or shoulder. Further, these regional pain syndromes have been considered distinct entities from "widespread" pain syndromes. However, examination of the epidemiology of these syndromes reveal much in common, and thus considering each separately may be imposing artificial distinctions and obscuring important aspects of aetiology.

The prevalence of generalised pain in the population

The variety of definitions used in the study of widespread pain and fibromyalgia (of which widespread pain is one feature) makes difficult, direct comparison of measures of occurrence between studies. Those conducted in hospital settings, most often in rheumatology or other specialist clinics do not provide information on population occurrence, are difficult to interpret in terms of a reference population and will therefore not be considered further. In the general population, while one would clearly wish to have a measure of both the incidence (a measure of the rate of symptom onset) and the prevalence (a measure of the burden of symptoms in the population at one point or over a specified period), measuring incidence is problematic given the episodic nature of symptoms and consequent difficulty in defining the precise onset. All population studies to date, therefore, have provided only an estimate of symptom prevalence.

Chronic generalised pain

Two large population-based studies have provided information on the descriptive epidemiology of widespread pain (using the ACR definition of chronic widespread pain which are part of classification criteria for fibromyalgia). The first in the United States involving 3006 adults who completed a mailed questionnaire (a participation rate of 75%), found a prevalence of 10.6%, 95% CI (9.5,12) (Wolfe et al, 1995). Croft et al (1993) conducted a similar survey in the United Kingdom with 1340 subjects (75% participation rate), and applying the age- and sex- specific prevalence rates to the adult population of England and Wales, estimated the national prevalence at 11%. These findings that around 1 in 10 of adults have chronic widespread pain is broadly in line with other population studies, such as by Crook et al (1984) in Canada which reported a prevalence of 11% for persistent pain (defined as "often troubled by pain") and in the first National Health and Nutrition Examination Survey in the United States which reported a prevalence of 14% for chronic pain in the back, hip, knee and/or other joints (Magni et al, 1990).

A study amongst 1756 schoolchildren (aged 10 and 12 years) in Finland found that widespread pain was common at young ages also. The prevalence of widespread pain (using the ACR definition) experienced "at least once a week" was 7.5% (Mikkelson et al, 1997)

Fibromyalgia

In the study by Wolfe et al (1995) discussed above, subjects were classified as having chronic widespread pain based on responses to a mailed questionnaire and were thereafter examined for tenderness. The overall prevalence of fibromyalgia was 2.0%, 95% CI (1.4, 2.7). In comparison to those who were married, divorced persons were significantly more likely to have fibromyalgia, and risk increased with lower levels of education and income. Makela and Heliovaara (1991) in an earlier study of fibromylagia from Finland (using criteria of "widespread pain" in addition to specific combinations of characteristic symptoms and tenderness on examination (Yunus, 1989) reported a prevalence of 0.8% in a population of 7000 adults aged over 30 years. Those who did not complete elementary level education had a considerably higher prevalence (2.8%) in comparison to those with elementary (0.7%) or secondary education (0.2%).

There is less information on the occurrence of fibromyalgia amongst schoolchildren, although a study by Mikkelson et al (1997) in Finland (using a two stage design and classifying subjects with the ACR criteria) found a prevalence of 1.3% amongst 1756 children aged 10-12 years. However an earlier study by Buskila et al (1996) among 338 schoolchildren aged 9-15 years in Israel, which also used the ACR criteria for fibromyalgia, found a considerably higher overall prevalence of 6.2%. Although there is a considerable discrepancy between these estimates of occurrence, it does at least suggest that the symptoms which together are labeled "fibromyalgia" are present from early life onwards.

In summary, chronic generalised pain is reported by around 10-11% of the population with, as noted previously, higher rates in middle and older age and amongst females. Fibromyalgia, the co-occurrence of chronic widespread pain and tenderness is less common, with a prevalence between 1-2% of the population with higher rates amongst persons of lower education and with lower incomes. Although based on few studies, broadly similar rates of occurrence have been noted in children.

Is there evidence for distinct risk factors between generalised pain and regional pain?

Occurrence

Firstly let us consider whether, on the basis of patterns of occurrence alone, regional and generalised pain syndromes can be distinguished. In a recent study of persons presenting to primary care with a new episode of low back pain, 15% satisfied the definition of widespread pain used in the ACR criteria for fibromyalgia (Macfarlane et al, 1999b). In a further population based study of pain (Hunt et al, 1999) the distribution of number of painful sites in the body (based on the Manchester classification (Macfarlane et al, 1996b), which divides the body into 26 areas) shows that pain at multiple regional sites is common (Figure 10) with no clear distinction between single and multiple site syndromes. If this is indeed so we may expect also that the aetiology of generalised or multiple site pain may share common risk factors with the aetiology of pain at individual sites.

Aetiology

The aetiology of pain has been studied primarily in relation to psychological, mechanical, general health and individual factors. Chronic widespread pain, using the definition in the ACR criteria for fibromyalgia, is more common in the United Kingdom population amongst females (16%) compared to males (9.4%) (Croft et al, 1993), with similar rates reported from the United States (Wolfe et al, 1995). In both sexes it increases in prevalence with age until the seventh decade and decreases at older ages (Figure 11b). Low back pain and shoulder pain are the commonest site for regional pain to be reported amongst the population. Although they have higher prevalence rates, they both have in common with widespread pain the features of a female excess and the "bell" shape of the age-prevalence curve (Figures 11a-c; Papageorgiou et al, 1995, Wolfe et al, 1995; Andersson et al, 1993)

Aetiological factors in relation to widespread pain and fibromyalgia have been studied primarily through cross-sectional studies involving clinic patients or the general population. Such studies are able to identify prevalent rather than incident symptoms and factors associated with widespread pain rather than aetiological factors *per se*. It is a consistent finding that subjects with chronic widespread pain are more likely to report high levels of psychological distress than subjects who do not have chronic widespread pain. These higher levels of psychological distress may either precede or be a consequence of chronic pain, and two studies suggest that there is in fact a relationship in both directions i.e. psychological distress amongst subjects pain free increases the risk of future pain while chronic pain amongst subjects free of distress confers a higher risk of future psychological distress (Magni et al, 1994; Hotopf et al, 1998). Moreover, amongst subjects with widespread pain psychological distress has been shown to predict chronicity of symptoms (Macfarlane et al, 1996a). Recent studies have shown that similar conclusions hold for regional pain syndromes. High levels of psychological distress amongst subjects without pain is a strong predictor for future low back pain and in particular a chronic episode of low back pain (Frymoyer et al 1985, von Korff et al, 1993b). Independently of psychological distress the distribution of reported pain also predicts outcome - those who consult primary care with low back pain (only) have a better outcome than those who consult with low back pain but also have pain widespread throughout the body (Macfarlane et al 1999). Similarly psychological distress amongst community subjects with shoulder pain has been shown to be a predictor of chronic shoulder symptoms (Macfarlane et al, 1998). It therefore appears that psychological distress is a shared aetiological factor for both regional and chronic pain, while psychological distress and the distribution of pain reported both independently predict the outcome of a pain episode.

The second major aetiological factor studied has been mechanical factors, these relate both to “internal” mechanical factors such as anthropometry and “external” factors such as mechanical load, posture, and repetitive movements. Currently, there is no published data which allows a direct assessment of whether such mechanical factors are either associated with widespread pain or whether exposure predicts future onset. Some indirect information comes from a study by Buskila et al (1997) who found that amongst 102 patients with an acute soft tissue injury to the neck 22% were diagnosed with fibromyalgia following injury, in comparison to 1.7% of a control group of 59 subjects who had experienced a leg fracture. This suggests that trauma may be involved in the aetiology of fibromyalgia although risk may depend on the type, site and circumstances of the trauma. Further studies examining the role of mechanical factors in the onset of generalised pain syndromes (including those experienced in the workplace) are underway. In contrast, mechanical factors have been extensively studied with respect to regional pain syndromes. An increased risk of low back pain has been reported with heavy physical work such as lifting heavy objects, pushing or pulling weights. Risk may be greatest when such manual tasks are associated with twisting and bending of the trunk. Symptoms are also more common in those who experience whole body vibration such as car or lorry drivers. Finally traumatic injuries are clearly associated with symptoms although are relatively uncommon in population terms (Riihimaki, 1995). Similarly, shoulder pain has been associated with load factors e.g. carrying weights on the shoulder, and postural factors such as working with hands above shoulder level, and repetitive movements of the arms or limbs (Sommerich et al 1993; Pope et al, 1997).

In summary, the evidence from the epidemiology of regional and widespread pain syndromes is that these are unlikely to be distinct entities. Instead they appear to be part of a continuum ranging from no pain to widespread pain (Figure 12). Towards the left of the continuum is pain which is acute and localised, and towards the right, pain which is chronic and widespread. This continuum may also be helpful when considering aetiology: acute localised pain is more likely to have a mechanical aetiology and with increasing duration and anatomical distribution of pain, adverse psychological factors tend to predominate.

Does regional pain lead to generalised pain

If regional pain is part of a continuum from no pain to chronic generalised pain, is it part of the pathway in development of generalised pain? There are few prospective studies of pain in the population which allow us to examine the development and persistence of chronic pain. A practical difficulty, however, in conducting such studies is that a large number of patients would require intensive follow-up to ascertain changes in pain status. One small study included 141 subjects who were asked about pain at two time points, a median of 27 months apart. Of those subjects with regional pain at baseline (pain which did not satisfy the ACR criteria for chronic widespread pain), 65% still reported regional pain at follow-up, 16% reported no pain and 19% reported chronic widespread pain. All those subjects with chronic widespread pain at follow-up had reported chronic widespread pain (46%) or regional pain (54%) at baseline (Macfarlane et al, 1996a). Clearly most acute regional pain does not therefore progress to chronic widespread pain, but evidence, particularly from low back pain studies has identified factors, summarised in a review by Turk (1997), which are associated with transition from acute to chronic (and possibly widespread) pain. These include high levels of anxiety and depression, perceived stress, substance abuse, coping resources, poor social support and perceptions of health and current symptoms.

Risk factors for the onset and persistence of generalised pain

Onset

Subjects with chronic widespread pain commonly report other co-morbidities such as high levels of fatigue, sleep disturbance, psychological distress and other somatic symptoms (such as bowel and urinary symptoms). The temporal relationship of onset between such symptoms has yet to be elucidated although two studies have examined psychological and psychiatric factors in relation to pain. In the National Health and Nutrition Survey I (NHANES I) of approximately 3000 adult subjects in the United States, amongst those who were free of pain at the initial survey, depressive symptoms (assessed using the Centre for Epidemiologic Studies Depression Scale (Radloff, 1977)) predicted chronic musculoskeletal pain (defined as pain present on most days during at least one of the past 12 months) eight years later (OR=2.1). Conversely, amongst those who did not have depression at initial survey, chronic pain was the most powerful predictor for depression at follow-up (OR=2.9) (Magni et al, 1994). A further study, the Medical Research Council National Survey of Health and Development, of approximately 3000 subjects in the United Kingdom examined a population-based birth cohort at ages 36 and 43 years. Psychiatric disorder (measured at age 36 using the Present State Examination (Wing et al, 1974)) predicted the reporting of a variety of physical symptoms at follow-up (amongst those initially free of symptoms). Symptoms included backache (OR=1.9 95% CI (1.1-3.3)), chest pain (OR=2.5; 1.4-4.6) and abdominal pain (OR=2.6;1.5-4.7). Further, amongst those without psychiatric disorder at 36 years, each of the previous symptoms predicted its onset at follow-up (backache (OR=1.5; 1.1-2.0), chest pain (OR=1.5; 1.1-2.0) and abdominal pain (OR =1.8;1.2-2.8)) (Hotopf et al, 1998).

In cross-sectional studies, Hudson et al (1992) found higher rates of psychiatric diagnoses in fibromyalgia patients when compared to rheumatoid arthritis patients (64% v. 22% for major mood disorders) while Aaron et al (1996) confirmed this finding when comparing fibromyalgia patients with other clinic patients and community volunteers. The latter study however found that higher rates of lifetime psychiatric disorders were confined to those subjects classified as having fibromyalgia (using the ACR criteria) who had consulted with symptoms, and the authors suggest that the association of fibromyalgia with psychiatric factors may in part be due to the influences upon consultation. Amongst children (aged 10 and 12 years), Mikkelson (1997) reported that in comparison to those without pain, children with widespread pain had more emotional and behavioural problem as assessed by both children themselves and their parents. They also more commonly reported depressive symptoms and sleep problems.

Finally, recent studies have investigated the relationship between a history of abuse and subsequent fibromyalgia. Physical and sexual abuse have been reported to be more common in subjects with fibromyalgia in comparison to control groups (Taylor et al, 1995; Boisset-Pioro et al, 1995), and amongst those with fibromyalgia, greater use of health services and medications for pain (Alexander et al, 1998). However the differences observed have been small in magnitude, the studies have involved relatively few subjects, with unsatisfactory control groups or low participation rates. Given the difficulties of collecting this type of information, particularly with respect to differential recall between symptomatic and asymptomatic subjects, the results to date must be considered preliminary and "hypothesis-generating" rather than indicating any link between abuse and future symptoms.

Persistence

Follow-up studies of subjects with generalised pain have primarily involved patients who have consulted with fibromyalgia. These generally show that such patients are difficult to treat and rarely show symptoms improvement. In a United Kingdom study of 72 patients diagnosed with (primary) fibromyalgia and who were followed up after 4 years, 70 (97%) still had symptoms consistent with fibromyalgia while 61 (85%) continued to satisfy the criteria used for diagnosis (Ledingham et al, 1993). In the United States, Felson and Goldenberg (1986) reported that in following prospectively 39 patients over an average of 1.3 years, 60% had moderate to severe symptoms throughout follow-up and almost all subjects continued to take medication. Younger patients and those with initially less severe symptoms had the best outcome. In a study of 37 children (mean age 10 years) who attended a rheumatology clinic with chronic musculoskeletal pain for which no physical origin could be found, 59% still had pain at 9 years follow-up. Predictors of persistent pain were generalised pain on first admission and a low mother's education level (Flato et al, 1997). Clinic studies, especially when conducted within specialist referral centres, inevitably include those subjects with the most severe and intractable symptoms and therefore may not reflect the natural history of such symptoms amongst unselected populations.

A natural history study of chronic widespread pain in the community suggests a more favourable outcome. Of 141 subjects who were followed over a 2 year period only 12 out of 34 subjects who originally satisfied the ACR definition of chronic widespread pain, had chronic widespread pain at follow-up. Those subjects with chronic widespread pain initially, who in addition had a high tender point count, high levels of psychological distress, fatigue or sleep problems were most likely to have symptom persistence (Macfarlane et al, 1996a). This high rate of improvement may indicate that chronic widespread pain, particularly in isolation, may have a generally better outcome than when part of a syndrome of other physical symptoms and signs. A population-study of 564 children with pain (mean age 10 years) in Finland, reported that half still reported pain one year later. The results generally agree with those from the adult study - pain at follow-up was more common amongst girls, and those at recruitment who were older, reported depressive feelings, day tiredness and disability arising from symptoms (Mikkelsson et al, 1998).

Summary

Current evidence, relating to patterns of occurrence and aetiology, suggests that generalised pain syndromes should be considered at one end of a spectrum of pain from no pain to chronic widespread pain. Mechanical and adverse psychological factors have been shown to be important in the aetiology of pain onset with the former predominating in acute regional pain and the latter in more persistent and generalised pain episodes. Chronic widespread pain is common in the population, with around 10% of the population satisfying a definition used by the American College of Rheumatology. Female sex, low levels of education and income, adverse psychological factors (in particular psychiatric disorder) are related to symptom onset. The influence of early life factors has been suggested but not confirmed while little is currently known about the natural history of symptoms and particularly about factors influencing outcome.

Research Agenda

- specific pain syndromes should be considered as part of a pain spectrum in epidemiological research studies rather than as distinct entities
- research studies are required which examine the relationship between the onset of generalised pain syndromes and other somatic symptoms
- studies examining the aetiology of generalised pain syndromes and other somatic symptoms could usefully focus on establishing whether there is a relationship between early life events and the onset of symptoms. This will require either

prospective studies, or retrospective studies with high quality/validated "exposure" information

- A fuller understanding of the natural history of generalised pain syndromes, and particularly on factors affecting outcome, may be particularly valuable in informing future treatment studies.

CHAPTER 6 SUMMARY

6.1 Introduction

How has this body of work added to our knowledge about the epidemiology of regional and widespread pain syndromes? Firstly, the previous section examining the relationship between regional and widespread pain syndromes has demonstrated that instead of considering chronic widespread pain (and the clinical syndromes, such as fibromyalgia, of which it is a feature) as a separate entity, it should be considered part of a continuum including no pain, regional pain and widespread pain syndromes. Chronic widespread pain is one extreme of that continuum. The basis for proposing a "pain continuum" is that all these syndromes share some common features in terms of their epidemiology of onset.

6.2 Aetiology of onset

The common features for regional and widespread pain syndromes which influence risk of onset include:

6.2.1. Constitutional factors

Gender: Almost all pain syndromes were found to be more common amongst women than men. Early clinical observations, particularly with respect to chronic widespread pain/fibromyalgia had suggested that these were almost exclusively conditions affecting women. The population and occupational studies presented in this thesis demonstrate that although regional and widespread pain syndromes are more common in women than in men, the sex ratio is only approximately 3:2. Papers B and K demonstrated that women were more likely to consult for symptoms of low back pain and chronic widespread pain, although the excess in the latter study was small. The predominance of women in specialist clinic settings is therefore likely to be a combination of the factors that women with the condition are more likely to seek a consultation and then to be referred on to specialist clinics. This is likely to be particularly true for chronic widespread pain in the presence of significant co-morbid features.

Age: The age prevalence curves for regional and widespread pain syndromes were generally similar. Prevalence increased throughout adult life until the 6th or 7th decade and then decreased thereafter. This has been demonstrated for both men and women. There are two interesting aspects to the age-prevalence curves: the increasing rate throughout much of adult life and the decreased rates thereafter.

Why do rates fall at older ages? It could be as a result of a birth cohort effect i.e. rates of pain reporting are influenced by the period of birth and that higher rates at older ages will be observed once the "cohorts" currently in their 6th and 7th decades reach older ages. While technically possible, there are at least two pieces of evidence which argue against this. Firstly, many of the risk factors studied are "environmental" and associated with current exposures. These include mechanical (injury) factors, and adverse psychological factors. It is much more likely that changes in these exposures would be manifest as a "time-period effect" (i.e. affecting everyone exposed at a given period of time, irrespective of age) rather than be determined by the birth time-period. Secondly, these age-prevalence curves have been reported over the past twenty years and if the pattern was due to a cohort effect one would have expected to see the higher rates in older ages being observed in more recent data. This is not the case. Possible alternative reasons for a decreased prevalence at older ages include a) people with regional and widespread pain syndromes experience increased mortality b) as one gets older there is an expectation of ill-health and therefore one might perceive aches and pains at old age as normal and not report them when questioned in surveys c) there is a short-term effect on risk factors for musculoskeletal pains and older people are simply less exposed to these factors. The one study available on regional pain syndromes and mortality suggests that any effect is very modest (Kareholt and Brattberg, 1998) and certainly unable to account for the size of decrease in prevalence observed in population-based epidemiological studies. Although Paper I in this thesis does demonstrate that people reporting widespread pain do have increased mortality, the effect is not large enough (and not confined to the older ages) to account for the decreased prevalence at the older ages. Hypothesis b is plausible and could be tested by questionnaire survey with follow-up interviews. Hypothesis c however has generally been considered most likely to be true. Indeed it is this shape of the age-prevalence curves which have been put forward as an argument on the likely importance of occupation (and by implication mechanical/injury factors) on symptom onset. As more has been understood about the aetiology of regional pain syndromes however it could equally be considered as indicating the importance of psychosocial factors in the work-place or indeed the cumulative effects of non-work place exposures.

6.2.2 Mechanical (Injury) factors

Historically, the major aetiological factor for regional musculoskeletal pain has been considered to be mechanical factors with the implication that the musculoskeletal disorder/pain arose through tissue injury. Such factors include posture, mechanical load and repetitive movements (of the upper limb). The role of these factors was suspected from observations that certain physical occupations had high levels of certain musculoskeletal disorders. In the 1990 Labour Force Survey in England and Wales musculoskeletal complaints were particularly common in coal miners (13% of workforce with persistent symptoms), construction workers, transport workers and nurses (each with 5% of workers). Within the transport workers group, particularly high rates of persistent symptoms were noted for goods porters, stevedores and dockers (Hodgson et al, 1993). These observations of high rates in those whose work involves high mechanical load is not confined to recent times. Writers and scribes in the early 19th century, and telegraph operators in the late 19th century were noted to commonly complain of forearm pain (Dembe, 1996). The studies reported in this thesis (and others) have confirmed that certain mechanical exposures are not only associated with symptoms but that these predict symptom onset. This latter observation is important since mere associations (observed through cross-sectional studies) may arise as a result of recall bias between subjects with and without symptoms. Prospective studies overcome this methodological weakness. Paper D, which is the first population prospective study examining the onset of forearm pain, demonstrated that those for whom repetitive movements of the arms or wrists were a common feature of their workplace were at 3-4 fold increased risk. Similarly the population study presented in Paper A showed that an occupational history of carrying weights on shoulders, working with hands above shoulder level and using wrists in a repetitive way were associated with a 2-5 fold increased odds of shoulder pain. Finally the prospective study of low back pain, presented in Paper B found that prolonged periods of standing or walking and lifting or moving weights above 25lbs (women only) conferred increased risk of low back pain (2 fold increased odds). Overall however the number of mechanical factors identified was small and the size of associations relatively modest. In comparing these results with others it should be remembered that the papers in this thesis have been conducted across populations (either the general population, workers from the general population, or working populations) and have not concentrated on groups with extremes of exposure. In this sense it is perhaps not surprising that the magnitude of effect noticed is small, particularly in relation to studies in other occupational settings. A further methodological aspect in considering these results is the possibility that the instruments used in these studies were poor measures of the mechanical factors of interest. Random errors in the assessment of these exposures would lead to risk estimates which were biased towards the null. For this reason another study (not presented in this thesis) involved validation of a questionnaire to measure workplace mechanical exposures (Pope et al, 1998). Subsequent use of this questionnaire in a study of shoulder pain in the workplace has confirmed a small number of mechanical factors each with modest effect on risks (Pope et al, 2001).

One aspect which has not been studied in this thesis and rarely elsewhere is the role of mechanical factors in influencing the onset of widespread body pain, and this is discussed further later.

6.2.3. Psychological and Psychosocial factors

One of the major contributions of the work in this thesis is to the understanding of how psychological and work-place psychosocial factors relate to symptom onset. In the work undertaken "psychological factors" refers to levels of psychological distress. Work-place "psychosocial factors", following the model of Karasek (1979), measure demands (i.e. how hectic and how stressful work is), support (i.e. the support one receives from colleagues and supervisors) and control (i.e. what control do you have over how your work is done, do you learn new things). Overall satisfaction with a job, and perception of adequacy of income were also included in these measures. The precise measures used in the various studies differed, a reflection of the on-going work in the field of psychosocial factors and hypotheses about their influence.

In relation to shoulder pain onset, a history of undertaking work either with high demands (stressful work) or low demands (monotonous work) was associated with an approximate doubling of risk. The risk of future forearm pain was increased by high job demands (hectic, fast or stressful work), low job demands (monotonous work) lack of control over one's job and dissatisfaction with support from colleagues and supervisors. The magnitude of the increased risk for these factors ranged from 2-5 fold. Further in a multivariate model predicting the onset of forearm pain, dissatisfaction with support remained an independent predictor of onset (after controlling for psychological distress, illness behaviour and mechanical factors). In the study of low back pain (Paper B) a perception of an inadequate income and a dissatisfaction with work were associated with an increased risk of future low back pain (no questions on demands, support and control were asked). However Paper C examined whether these factors were specifically related to work and found that the relationships with inadequacy of income and satisfaction with employment status (rather than with job) were maintained even in those who were not in employment. The role of adverse work-related psychosocial factors has not been examined in relation to chronic widespread pain in this thesis nor in any other published study to date.

The only study in this thesis to examine psychological distress as a possible risk factor for regional pain syndromes, was the prospective study of forearm pain. It demonstrated a strong relationship between both intermediate and high levels of distress and an approximate doubling of the risk of forearm pain onset. Psychological distress remained an independent predictor of onset in a multivariate model, which included dissatisfaction with support received. This implies that adverse psychosocial factors are not simply a reflection of high levels of distress. Although not included in this thesis, the South Manchester Low Back Pain Study has previously reported that high levels of psychological distress are associated with a doubling in risk of low back pain over the subsequent twelve months (Croft et al, 1995). In the same way that high levels of distress predict the onset of these two regional pain syndromes, they were also shown in Paper E to double the risk of onset of chronic widespread pain. One could therefore hypothesise that such regional and widespread pain syndromes were, in some instances, a manifestation of somatisation.

6.2.4 Regional and widespread pain syndromes: a feature of somatisation?

Using the prospective studies on forearm pain (Paper D) and chronic widespread pain (Paper E) the hypothesis that both of these could be one manifestation of the process of somatisation was examined. Formal somatisation disorders, meeting agreed diagnostic criteria, were not studied since these are rare in the population. However the reporting of other likely somatic symptoms was associated with a two-fold increased risk of onset for forearm pain and three-fold for chronic widespread pain. While health anxiety was only weakly related to pain onset, aspects of illness behaviour were the strongest predictor of onset of either syndrome and remained so in multivariate models. Adjusting for other factors which predicted onset, high scores on the Illness Behaviour sub-scale of the Illness Attitude scales were associated with an approximately six and nine-fold increased risk of onset of forearm pain and chronic widespread pain respectively. High scores on the Illness Behaviour sub-scale of the Illness Attitude Scales essentially identify those who have had frequent symptoms in the past about which they have sought a consultation and received treatment. Considering only the number of other somatic symptoms reported and illness behaviour score, those with low scores had a 1/100 risk of developing chronic widespread pain one year later, while reporting high scores on both scales increased risk to 21/100. This emphasises the strong influence of these two factors.

In summary musculoskeletal pain is more commonly reported in females and increases with age until the 6th or 7th decades, and decreases thereafter. Site-specific mechanical factors, including load posture and repetitive movements, increase the risk of regional pain syndromes (e.g. lifting weights on shoulder for shoulder pain, repetitive movements of the wrist for forearm pain). Relationship with chronic widespread pain has not been examined. In addition psychological distress has been shown to predict onset of both regional and widespread pain syndromes and is not merely a consequence of symptoms. Independent of psychological distress, high (i.e. hectic or stressful work) and low (i.e. monotonous work) workplace demands, lack of support from colleagues/supervisors and lack of control over how to conduct work also increase risk of symptoms. Further, report of other current somatic symptoms and a history of previous ill-health with consultation and treatment are major risk factors for regional or widespread pain onset. It should be emphasised that these are all new findings during the past decade from the work presented in this thesis.

6.3 Predictors of persistence

Having established the determinants and predictors of symptom onset, what factors predict chronicity of symptoms? Using the results from the prospective studies of shoulder pain, low back pain and widespread pain it can be concluded that generally women are more likely to have persistent symptoms than men and that the likelihood of persistence increases with age. This latter observation may be as a result of a greater likelihood of degenerative change. Risk of persistence is lowest in the absence of disability, co-morbidities, other somatic symptoms and for symptoms of shorter duration. Thus, in contrast to results from clinical studies, widespread body pain need not always be viewed as inevitably chronic. Psychological distress has been demonstrated as a strong predictor of persistence of shoulder, back and chronic widespread pain, with high levels of distress conferring a 2-3 fold increased risk. While decreased range of movement, particularly of the back, was associated with persistence this could be interpreted either as the influence of mechanical and/ or psychosocial factors.

In summary, it appears to be both clinical and psychological factors that influence the risk of persistence. Although the role of pre-morbid mechanical load and injury on persistence has not been examined specifically in this thesis there is no evidence overall for their effect (Van den Hoogen et al, 1997; Dasinger et al, 2000; Miedema et al, 1998; Burton et al, 1991; Coste et al, 1994). Identifying risk factors for persistence (or conversely improvement) early in the course of symptoms/disease is important both for identifying which groups to target treatment and identifying possible management/treatments for future study.

6.4 Other selected aspects of aetiology (not covered by papers included in the thesis)

6.4.1 Genetic factors

This thesis has concentrated on individual (constitutional) factors and environmental exposures. Although the former factors may arise or be a direct result of genetic influence, there has been little consideration of whether there is a genetic basis for regional and widespread pain syndromes. Where work has been conducted, it has principally focussed on fibromyalgia. Buskila et al. (1996) examined fifty-eight offspring of 20 female clinic patients with fibromyalgia in Israel. Sixteen offspring (28%) were found to satisfy criteria for the fibromyalgia syndrome according to the ACR criteria. Age-specific prevalence rates were compared with those from a population based study in the United States (Wolfe et al, 1995) and found to be higher, particularly in the youngest and oldest age groups (although numbers of subjects were small and the comparison group was not ideal). An excess could come about not only as a result of genetic factors, but due to common environmental factors such as anxiety, depression and illness behaviour. A further study from the same research group reported that the mean tender point count amongst relatives of female fibromyalgia patients was higher than an unmatched control population (Buskila et al, 1997). The few association studies which have been conducted of fibromyalgia with human leukocyte antigens (HLA) have provided conflicting results. Hørven et al. (1992) found no association with HLA in a study of 60 fibromyalgia and 159 healthy controls, while a another study of 52 fibromyalgia patients and 869 healthy controls found a significant association with HLA B58, DR8 and DR5 (Branco et al, 1996). A recent linkage analysis of 40 multicase families with fibromyalgia suggested that there may be some linkage to the HLA region although the effect noticed was modest (Yunus et al, 1999). In summary, the studies to date in this area are few, generally involving small groups of subjects and using unmatched and selected control groups. Further work is required before one can draw any conclusion about the role of genetic and family environment factors in chronic widespread pain and fibromyalgia.

6.4.2 Hormonal Factors

Although the observation has been made of differing prevalence rates between males and females both of regional and widespread chronic pain syndromes, the role of sex hormones on the occurrence and severity of symptoms is largely unknown. One retrospective study of a small group of 26 women with fibromyalgia found that they reported worsening of symptoms during pregnancy and a further worsening of symptoms in the post-partum period. However, the hormonal changes associated with abortion, or oral contraceptive use were not associated with changes in self-reported symptoms (Ostensen et al, 1997). Therefore, although there is a scientific argument for a possible role on onset of and persistence of symptoms this has yet to be demonstrated in any large epidemiological study.

An exception to the above conclusion is the demonstration of a link between hormonal factors and one clinical entity associated with forearm pain – carpal tunnel syndrome. The Oxford Family Planning study involved prospective follow-up of 17032 women attending family planning clinics in the United Kingdom (Vessey et al, 1990). The outcome of interest was first referral rates for carpal tunnel syndrome (n=154). Rates of referral amongst users of oral contraceptive for 10 years or more were more than double that of non-users: these associations remained even after adjusting for possible confounding factors including age and body mass. This observation of an association with duration of oral contraceptive use is supported by studies of Sabour and Fadel (1970) and de Krom (1990). Although a United States case-control study of subjects (cases: 626, controls: 3618) undergoing carpal tunnel release within medical care programmes involved subjects too old to examine the influence of oral contraceptives, the use of oestrogen replacement therapy was associated with case status (Solomon et al, 1999). Carpal tunnel syndrome has also been associated with menstrual disorder and the menopause (Vessey et al, 1990; Ferry et al, 2000; Pascual et al, 1991). Biological mechanisms linking hormonal factors with carpal tunnel syndrome have usually related to fluid retention.

6.4.3 Early life factors

The hypothesis has been put forward that early life "psychosocial" factors may influence health in adult life. This possibility has been proposed particularly in relation to chronic widespread pain (fibromyalgia) and other unexplained or somatic symptoms. If true, their effect may be mediated through psychological distress (or formally, mental disorder) in adult life. A relationship between adverse early life factors and fibromyalgia in adulthood has gained credence recently but a critical examination of the evidence is necessary. Boisset-Poiro et al (1995) compared 83 female fibromyalgia clinic patients to 161 clinic subjects with other rheumatic disease. Overall there was no statistical difference in the rates of reporting of abuse (at any time) between the two groups, although childhood physical and sexual abuse were more common amongst fibromyalgia patients. Another clinic study comparing 104 patients with fibromyalgia with 44 patients with rheumatoid arthritis also found an association between fibromyalgia and childhood physical and sexual abuse (Carpenter et al, 1998) while a study amongst patients with fibromyalgia found that those reporting a past history of abuse were characterised by having greater pain, disability and levels of stress (Alexander et al, 1998). Not all studies, however have found differences in reported rates of sexual abuse (Taylor et al, 1995). In interpreting these "positive" studies it is important to consider that they are conducted in selected (clinic) patient groups, they all have low participation rates in the fibromyalgia and/or "control" groups and, given the delicate nature of the subject, are clearly open to the potential for differential recall of past events between subjects with and without current symptoms. An analysis recently conducted (using data from the Altrincham Pain Study) found that subjects with chronic widespread pain (in comparison to those without chronic widespread pain) more commonly reported five adverse childhood (prior to 16 years) factors: illness in family members, parental loss/separation, abuse, hospitalisations and operations. When self-reports of hospitalisation and operation were compared with available medical notes there was strong evidence of differential recall of past events between subjects with and without chronic widespread pain. Very few subjects (with or without chronic widespread pain) reported hospitalisations or operations which were not recorded in the notes (i.e. potentially "false positive reports"). However if a hospitalisation or operation was recorded in the notes, subjects with chronic widespread pain always remembered to report it while those without chronic widespread pain forgot to report it about 50% of the time (i.e. "false negatives") (McBeth et al, 2001b). Such differential recall of hospitalisations and operations accounted for a substantial proportion of the association observed, based on self-report data. Determining whether there is an association between adverse childhood factors and chronic pain in adulthood will rely on future studies which need to overcome major methodological hurdles.

6.4.4 Mechanical (Injury) Factors in relation to widespread pain

Although many studies have researched the relationship between mechanical (injury) factors and regional pain syndromes their role in the aetiology of chronic widespread pain has received relatively little attention. There appears to be acknowledgement in the literature that previous trauma can be related to symptoms, but there is a lack of well designed studies to substantiate this. Makela and Heliovaara (1991) in a population survey reported that the prevalence of fibromyalgia was more than twice as common in those reporting high physical work load in comparison to those reporting low levels. A further study of 161 cases of traumatic injury found different subsequent rates of development of fibromyalgia according to site and type of injury: it was thirteen times more common in those with a neck injury in comparison to those with an injury of the lower extremity (Buskila et al, 1997). As noted with respect to investigating other potential aetiological factors, cross-sectional or retrospective studies relying on self-reports may be affected by differential recall and attribution by those with and without chronic widespread pain. Given the availability of data within the Altrincham Pain Study to investigate this, an analysis is currently underway.

6.4.5 Infection

The possible role of infection has been investigated as a possible precipitating factor for the onset of chronic widespread pain. One prospective study conducted amongst 150 subjects with acute infectious mononucleosis (AIM) (enrolled around the time of diagnosis) found that while 19% of subjects satisfied ACR criteria for fibromyalgia at enrolment, prevalence rates subsequently fell to 3% and 1% at 2 and 6 months follow-up (Rea et al, 1999). The authors concluded that a tender point count and fibromyalgia were infrequent sequelae of AIM. Indeed at follow-up a high tender point count was predicted by older age, female sex, less family social support, and baseline tender point count, rather than any baseline laboratory tests.

6.5 The way forward: What are the future priorities for epidemiological investigation of regional and widespread pain syndromes?

The work in this thesis has addressed important aspects of the epidemiology of musculoskeletal pain and, together with other contemporary work, increased our understanding of the epidemiology of these conditions. This short final section considers the direction of future work. One of the most important aims of epidemiology is to understand sufficiently the aetiology of disease, so that through prevention, the burden of disease may be reduced. This may include primary prevention (e.g. in potentially high-risk work-place settings) or secondary prevention (e.g. at the time of consultation to primary care).

One aspect that has been hypothesised as having a major influence on an individual's willingness to report and seek help for certain conditions, is the prevailing social and medical opinions about these conditions, including their impact and their causes. The legal system in place may also have an influence. Recent decades have seen an explosion in the amount of money spent by governments of industrialised nations on sickness benefits as a result of low back pain. There are likely to be many reasons for this but these will include 1) greater awareness of the ability of work to detrimentally affect health 2) a greater expectation of good health 3) an understanding of what factors can cause low back pain, partly as a result of publicity in the media 4) an expectation that if your "back is damaged" then someone/something else may be "responsible" for this 5) greater responsibilities of employers 6) the social security system in place 7) the willingness of doctors to ascribe low back pain to a work-related cause. Although these particularly relate to consequences of low back pain in the workplace they may equally apply to the reporting of low back pain in general. However, by definition, current studies are generally not able to look at these influences other than, for example a change in current legislation. There are two possible ways to achieve an insight on their influences – both are essentially observational. Neither will prove these effects but may indicate whether the data support the hypotheses. The first is by historical studies looking at the evidence of changes in the prevalence of musculoskeletal pain reporting through history in relation to some of the influences noted above – this is essentially an ecological study using different time periods rather than different geographical units of observation. The second is to study countries with different social influences, and differences in legal statutes medical opinion and the extent of media publicity relating to musculoskeletal disorders. A further aspect may include studying the effect of culture between different ethnic populations living in the same country. Although no work has specifically been conducted in this area with respect to the epidemiology of musculoskeletal pain, there has been some research done on the outcome of neck injury after a car crash (whiplash) in Lithuania and Canada. Symptoms are shown to be chronic in Canada much more frequently and this is hypothesised to be partly a result of social and legal issues influencing subjects' expectations (Ferrari et al, 1999; Schrader et al, 1996). The difficulty of such studies however is their inability to take account of potential confounding factors.

Work has demonstrated the potential influence of both physical factors psychological distress on the onset and outcome of symptoms. There is now a general realisation of their importance by many health care providers. Epidemiological work has identified certain risk factors. Given that one of the aims of epidemiological investigation is to characterise risk factors sufficiently to allow studies of primary and secondary prevention to be designed, it is important to consider knowledge in that context. It is possible to consider primary prevention studies in high-risk population (i.e. occupational) groups and to consider secondary prevention studies in primary care. In certain cases (e.g. re: mechanical load, work autonomy) current evidence may provide sufficient evidence on a risk factor on which to proceed with testing hypotheses about prevention in intervention studies. In other cases the measurement of exposure is too general at present. What aspect of posture results in increased risk of regional pain syndromes (duration, abnormality of posture, combination of posture and load)? What aspect of repetitive movements are injurious (speed, cycle time, frequency)? Similarly, although strong consistent associations are demonstrated between high levels of psychological distress and onset of pain syndromes, more specific measure(s) of distress (e.g. anxiety, depression, catastrophising, locus of control) would be preferable in order to plan specific interventions.

The application of some of our knowledge on aetiology and outcome of pain syndromes from epidemiological studies is in its infancy. There are many methodological and practical problems to be overcome. Even a relatively well defined "physical" intervention can be difficult to implement in work-place settings for practical reasons and initial measures of outcome may be problematic and not always encouraging (Trevelyan, 2000). Psychosocial interventions (e.g. implementing changes in support from managers, workplace autonomy, perceived demands) are even more challenging. The evidence suggests however that interventions only on the physical exposures in the workplace may have limited benefit.

Traditionally, epidemiologists have sought to validate any instruments used in studies. Essentially this means ensuring that they are measuring what they are supposed to measure. However with respect to psychosocial measures such validation has rarely been conducted. There are arguments for and against such validation. Firstly it may be that some persons simply have a generally lower threshold for complaining about health, and adverse workplace factors. By having a validated measure of psychosocial factors in the workplace one could overcome this "artefactual association" between them. However the alternative argument is that the important features of the workplace is how the individual perceives the psychosocial environment. An independent observer may not evaluate a particular job as stressful (e.g. working on a packaging production line), but if an individual perceives it to be stressful then that is what is likely to be important. Similarly one may independently evaluate some jobs as having high levels of stress (e.g. air traffic controller) but an individual working in this job may not perceive it as stressful. There are other factors which are even more difficult to independently evaluate (monotony, workplace relationships). Nevertheless it would be preferable for future studies to incorporate independent measures of psychosocial workplace factors (e.g. from line managers) and examine the effects of self-reported, externally evaluated and (perhaps crucially) disagreements between them in the role of musculoskeletal symptom onset.

The results from this study, particularly in relation to chronic widespread pain, have suggested that psychological distress through a process of somatisation leads to an increased risk of symptoms. If this is true then one would expect that such findings could be repeated for other "unexplained symptoms" which have been associated with psychological factors. These include other pain syndromes (e.g. irritable bowel syndrome), atypical chest pain and oro-facial pain (e.g. temporomandibular joint disorders). There are no comparable prospective studies amongst initially pain-free individuals for those syndromes but a single study which examined multiple syndrome outcomes would be able to address this hypothesis.

This thesis has considered self-reported regional pain syndromes rather than clinical diagnoses associated with such pain syndromes. The reason for this is that, initially, it is necessary to understand the aetiology of symptom onset and then for conditions with this symptom, to consider whether there is evidence of different aetiologies for different clinical syndromes. There are several methodological hurdles to be overcome. Firstly there is rarely agreed criteria for disorders, and these therefore need to be developed. For musculoskeletal conditions of the upper-limb a Health and Safety Executive sponsored conference in Birmingham in 1997 established such criteria by consensus (Harrington et al, 1998). Thereafter the validity of these criteria were demonstrated in the clinic and the community (Palmer et al, 2000). Having validated the criteria, these are being tested out in population studies and initial results suggest that physical factors may be more important in the aetiology of upper limb conditions when criteria for a specific upper limb disorder are satisfied. In contrast, psychological factors may predominate in non-specific conditions (Walker-Bone et al, 2001). Considerable further work in this area is required for this and other pain syndromes but it will allow us in future to determine the basis or otherwise (on the basis of aetiology and outcome) for distinct clinical diagnoses.

Finally, epidemiological work on environmental and individual factors is traditionally considered separately from laboratory work on the organic basis of disease. A good example of this is in chronic widespread pain/fibromyalgia. In parallel with population-based studies examining the role of psychological factors on disease onset, there is a considerable amount of work attempting to demonstrate muscle abnormalities, endocrine disturbance, disturbed sleeping patterns and biochemical abnormalities affecting nocioception. There is no reason that such research, where technical aspects allow, should not be integrated with population epidemiology. For example, in paper E, of persons exposed to both independent predictors of onset only 1/5 reported new symptom onset. The majority, however, did not. One could hypothesise that some of the important environmental factors may only increase risk of symptom onset in conjunction with organic abnormality. The evidence in favour of specific abnormalities is beyond the scope of this thesis, but it possibly represents a fruitful area for future research.

Epidemiology is often criticised as being primarily descriptive and only rarely contributing to significant advances in understanding the aetiology of disease and ultimately its prevention. Such criticism could not be attributed to the past decade of research in musculoskeletal pain syndromes. We now have a much greater understanding of their onset and outcome, and factors influencing both. We understand better the relationship between different regional and widespread pain syndromes and can hypothesise about a link with other "unexplained syndromes". Future research offers the exciting possibilities that we can both reduce the burden of this disabling condition in high-risk populations as well as reduce chronicity in the general population.

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Appendix 1

Tables

Occupational Activity	Males				Females			
	Controls N	Cases N	RR	95% CI	Controls N	Cases N	RR	95% CI
Lifted or carried weights > 25lbs	50	11	1.2	(0.4,3.5)	26	5	0.8	(0.3,2.2)
Carried weights on one shoulder	20	11	5.5	(1.8,17.4)	4	1	1.1	(0.1,8.1)
Stretch to reach below knee level	34	10	2.0	(0.7,5.7)	21	7	1.4	(0.6,3.3)
Work with hands above shoulder level	22	8	2.1	(0.8,5.8)	11	2	0.7	(0.2,2.9)
Work with bent posture	27	8	1.4	(0.8,2.6)	22	6	1.0	(0.5,1.8)
Used wrists in a repetitive way	39	11	2.0	(0.7,5.9)	40	14	2.0	(0.9,4.6)
Used arms in a repetitive way	43	11	1.7	(0.6,4.8)	36	9	0.9	(0.4,2.1)
Used vibrating machinery	17	4	1.1	(0.4,3.6)	15	3	0.8	(0.2,2.7)
Stood in one position with no breaks	14	3	1.1	(0.6,2.0)	14	5	1.3	(0.9,1.9)
Seated in one position with no breaks	22	2	0.4	(0.1,1.9)	18	3	0.7	(0.2,2.4)
Joint stiffness or aches/pains at end of day	30	9	2.2	(0.8,6.4)	25	6	1.3	(0.5,3.4)
Required rests/breaks due to aching muscles/joints	6	4	3.0	(0.9,9.6)	9	1	0.6	(0.1,4.5)

Table 1. **Physical activities at work in relation to shoulder pain and disability**

Occupation conditions		Males Controls N	Males Cases N	Males RR	Males 95% CI	Females Controls N	Females Cases N	Females RR	Females 95% CI
Damp	Never	56	5	1.0		95	20	1.0	
	Occasional	16	6	3.3	(1.0,11)	5	2	1.1	(0.2,5.1)
	Always*	6	5	5.4	(1.6,19)	0	1	3.3	(0.4,27)
Cold	Never	54	7	1.0		85	19	1.0	
	Occasional	23	6	1.8	(0.6,5.4)	11	3	1.4	(0.4,5.1)
	Always*	1	3	6.4	(1.5,27)	4	1	1.1	(0.2,8.5)
Hot	Never	50	8	1.0		77	14	1.0	
	Occasional	20	4	1.3	(0.4,4.2)	11	5	1.9	(0.7,5.4)
	Always*	8	4	2.4	(0.7,7.9)	12	4	1.5	(0.5,4.5)
Dusty	Never	51	8	1.0		81	15	1.0	
	Occasional	14	4	1.6	(0.5,5.4)	8	4	1.8	(0.6,5.5)
	Always*	14	4	1.6	(0.5,5.3)	11	4	1.6	(0.5,4.9)
Noisy	Never	41	8	1.0		68	15	1.0	
	Occasional	27	2	0.4	(0.1,1.9)	11	3	1.3	(0.4,4.8)
	Always*	11	6	2.2	(0.7,6.5)	21	5	0.9	(0.3,2.5)
Fumes	Never	50	11	1.0		90	22	1.0	
	Occasional	19	3	0.7	(0.2,2.7)	4	0	0.0	-
	Always*	10	2	0.9	(0.2,4.1)	6	1	0.9	(0.1,7.2)

Table 2. **Working conditions in relation to shoulder pain and disability**

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* Most of the time or always

	Males			Females	
Occupational Group	N*	Incidence rate %	Occupational Group	N	Incidence rate %
Overall	655	34	Overall	727	36
Construction Workers	42	40	Professionals	30	52
Clerical Workers	80	39	Domestics	73	44
Security/Armed Forces	24	39	Food Industry Workers	39	42
Drivers	59	38	Nursing	127	38
Professionals	64	36	Shop workers	98	37
Warehouse Workers	50	35	Managers	50	32
Metal Workers	49	33	Machine Operators	31	31
Shop Workers	32	31	Clerical workers	233	27
Machine Operators	88	28			
Managers	64	28			

Table 3. **Incidence rates of low back pain during 12 month follow-up period**

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* Number of subjects at baseline (only the most common occupational groups are presented)

	Males					Females				
Activities	No LBP	LBP - Consulters		LBP- Non Consulters		No LBP	LBP - Consulters		LBP- Non Consulters	
	N	N	OR (95% C.I.)*	N	OR (95% CI)*	N	N	OR (95% C.I.) *	N	OR (95% C.I.) *
Standing/walking > 2hrs										
No	73	4	1.0	37	1.0	107	6	1.0	34	1.0
Yes	157	18	2.1 (0.7,6.4)	73	0.9(0.6,1.5)	161	31	3.5(1.4,8.8)	87	1.8(1.1,2.8)
Sitting > 2hrs										
No	111	14	1.0	42	1.0	121	27	1.0	69	1.0
Yes	119	8	0.5 (0.2,1.3)	68	1.5(0.9,2.4)	147	10	0.3(0.1,0.6)	52	0.6(0.4,0.9)
Digging										
No	213	21	1.0	1055	1.0	267	37	1.0	119	1.0
Yes	17	1	0.6 (0.1,4.5)		0.6(0.2,1.6)	1	0	0.0	2	4.4(0.4,5.0)
Driving car > 4 hrs				89						
No	194	19	1.00	21	1.0	263	36	1.0	118	1.0
Yes	36	3	0.9 (0.3,3.3)		1.3(0.7,2.4)	5	1	1.6(0.2,1.4)	3	1.4(0.3,5.9)
Driving lorry				1037						
No	218	21	1.0		1.0	267	37	1.0	121	1.0
Yes	12	1	0.9(0.1,7.2)	60	1.2(0.5,3.1)	1	0	0.0	0	0.0
Lifting/moving > 25lbs				50						
No	129	11	1.0		1.0	226	26	1.0	83	1.0
Yes	101	11	1.2(0.5,3.0)		1.1(0.7,1.7)	42	11	2.3(1.1,5.0)	38	2.5(1.5,4.1)

Table 4. **Association between work activities and low back pain (LBP)**

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* All odds ratios are adjusted for age-group

		Males			Females		
Activities		LBP during follow-up year		Odds Ratio*	LBP during follow-up year		Odds Ratio *
		No	Yes	(95% CI)	No	Yes	(95% CI)
Standing/walking > 2hrs							
	No	56	12	1.0	78	16	1.0
	Yes	121	37	1.6 (0.8, 3.3)	94	54	2.9(1.5, 5.5)
Sitting > 2hrs							
	No	86	25	1.0	72	44	1.0
	Yes	91	24	0.9 (0.1, 1.5)	100	26	0.4 (0.2, 0.7)
Digging							
	No	164	45	1.0	171	68	1.0
	Yes	13	4	1.1 (0.3, 3.6)	1	2	4.8 (0.4, 54)
Driving car > 4 hrs							
	No	150	41	1.0	171	68	1.0
	Yes	27	8	1.1 (0.5, 2.7)	1	2	4.8 (0.4, 54)
Driving lorry							
	No	169	48	1.0	171	70	1.0
	Yes	8	1	0.5 (0.1, 4.0)	1	0	0.0
Lifting/moving > 25lbs							
	No	98	22	1.0	147	25	1.0
	Yes	79	27	1.5 (0.8, 2.8)	25	18	2.0 (1.01, 4.0)

Table 5. **Association between work activities and first ever episode of low back pain**

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* All odds ratios are adjusted for age-group

Activities	OR* (of back pain during follow-up year), 95% CI	
	Males	Females
Standing/walking for more than 2 hours		
Never	1.0	1.0
1-7 years	2.0 (1.1, 2.7)	1.6 (0.9, 2.9)
8-18 years	1.4 (0.7, 3.0)	2.2 (1.2, 4.1)
over 18 years	1.3 (0.6, 2.9)	2.0 (1.0, 4.2)
Lifting/moving weights of 25 lbs or over		
Never	1.0	1.0
1-7 years	2.0 (1.0, 3.8)	1.5 (0.8, 2.8)
8-17 years	1.5 (0.8, 2.8)	2.7 (1.5, 5.1)
over 17 years	1.3 (0.7, 2.4)	1.0 (0.4, 2.6)

Table 6. **Risk of reporting back pain associated with duration of exposure to selected activities**

Factor	Outcome during 12 month follow-up period				
	No LBP	Non-consulting LBP		Consulting LBP	
	Controls	Cases	OR (95% CI)*	Cases	OR (95% CI)*
Adequacy of income					
Adequate	293	131	1.0	24	1.0
Slightly inadequate	181	81	1.0 (0.7-1.4)	21	1.5 (0.8-2.7)
Marked/severely inadequate	57	33	1.3 (0.8-2.1)	16	3.6 (1.8-7.2)
Satisfaction with work					
Satisfied	356	131	1.0	35	1.0
Slightly dissatisfied	133	83	1.7 (1.2-2.4)	23	1.8 (1.0-3.1)
Marked/severely dissatisfied	39	28	2.0 (1.2-3.3)	3	0.8 (0.2-2.7)
Relationships at work					
No problems	443	193	1.0	49	1.0
Slight problems	78	46	1.4 (0.9-2.0)	12	1.3 (0.9-1.9)
Marked/severe problems	10	4	0.9 (0.3-3.0)	0	

Table 7. Psychosocial factors as a risk for a future episode of low back pain

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[*] Odds ratios are adjusted for age-group

Social class of working population	Outcome during 12 month follow-up period				
	No LBP	Non-consulting LBP		Consulting LBP	
	Controls	Cases	OR (95% CI)[*]	Cases	OR (95% CI)*
I & II	131	69	1.0	7	1.0
IIIN	178	68	0.7 (0.5-1.1)	21	2.2 (0.9-5.4)
IIIM	106	59	1.1 (0.7-1.6)	9	1.7 (0.6-4.6)
IV & V	111	45	0.8 (0.5-1.3)	26	4.8 (2.0-11.5)

Table 8. Social class as a risk for a future new episode of low back pain (consulting and non-consulting)

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[*] Odds ratios are adjusted for age-group

Baseline employment status	Employed					Non-employed[#]				
		Non-consulting LBP		Consulting LBP			Non-consulting LBP		Consulting LBP	
	No LBP					No LBP				
	Controls	Cases	OR (95% CI)	Cases	OR (95% CI)	Controls	Cases	OR (95% CI)	Cases	OR (95% CI)
Satisfaction with status										
Satisfied	356	131	1.0	35	1.0	282	96	1.0	22	1.0
Slightly dissatisfied	133	83	1.7 (1.2-2.4)	23	1.8 (1.0-3.1)	102	58	1.6 (1.1-2.4)	13	1.4 (0.7-3.0)
Severely dissatisfied	39	28	2.0 (1.2-3.3)	3	0.8 (0.2-2.7)	82	60	2.0 (1.2-3.1)	7	0.9 (0.3-2.2)
Perceived adequacy of income										
Adequate	293	131	1.0	24	1.0	165	81	1.0	7	1.0
Slightly inadequate	181	81	1.0 (0.7-1.4)	21	1.5 (0.8-2.7)	178	67	0.8 (0.5-1.2)	16	2.3 (0.9-5.8)
Severely inadequate	57	33	1.3 (0.8-2.1)	16	3.6 (1.8-7.2)	149	83	1.1 (0.7-1.6)	21	3.6 (1.4-9.0)

Table 9. **Psychosocial risk factors for a new episode of low back pain (LBP): comparison of the employed and non-employed**

[#] All subjects not in current part-time or full-time employment

	Total subjects	Number with forearm pain	Prevalence (%)
Overall	1260	105	8.3%
Sex			
Male	517	46	8.9%
Female	743	59	7.9%
Age group			
Overall			
18-39	308	18	5.8%
40-59	670	60	9.0%
60+	282	27	9.6%
Males			
18-39	116	6	5.2%
40-59	278	24	8.6%
60+	123	16	13.0%
Females			
18-39	192	12	6.3%
40-59	392	36	9.2%
60+	159	11	6.9%

Table 10. **Prevalence of forearm pain at follow-up**

Exposure at baseline	Forearm pain at follow-up		
	Yes	No	Age & sex adjusted RR (95%CI)
Back pain			
No	79	1056	1.0
Yes	26	99	2.8 (1.8-4.3)
Shoulder pain			
No	89	1081	1.0
Yes	16	74	2.1 (1.2-3.6)
CWP			
No	79	1045	1.0
Yes	26	110	2.6 (1.6-4.0)

Table 11. **Risk of forearm pain at follow-up: baseline pain status**

Assessment scores at baseline	Forearm pain at follow-up		
	Yes	No	Age* and sex adjusted RR (95%CI)
GHQ			
0	36	598	1.0
1-2	26	206	2.1 (1.2-3.4)
3+	36	241	2.4 (1.5-3.8)
Somatic Symptom Scale			
0	52	677	1.0
1	30	237	1.7 (1.1-2.6)
2-5	16	131	1.7 (0.95-3.0)
Illness Attitude Scales			
- Health Anxiety:	24	334	1.0
0-5	35	344	1.4 (0.8-2.3)
6-11	39	367	1.4 (0.8-2.3)
12-44			
- Illness Behaviour:			
0-3	12	348	1.0
4-7	33	356	2.4 (1.3-4.7)
8-24	53	341	3.8 (2.0-7.1)

Table 12. **Risk of forearm pain at follow-up: morbidities/illness attitudes**

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* Adjusted for three age-groups: 18-39, 40-59, 60+ years

Baseline exposure	Lift/carry weights with one/both hands			Pushing/pulling weights			Type for 30 mins without break			Repetitive movements of the arms		
	Forearm pain at follow-up			Forearm pain at follow-up			Forearm pain at follow-up			Forearm pain at follow-up		
	Yes	No	RR# (95%CI)	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)
Never	17	337	1.0	21	423	1.0	24	418	1.0	6	260	1.0
Occasionally	14	280	1.00 (0.5-2.0)	11	216	1.00 (0.5-2.1)	11	187	1.03 (0.5-2.1)	9	212	1.8 (0.6-5.1)
Half/most of the time	10	119	1.7 (0.8-3.6)	10	95	2.0 (0.96-4.3)	7	126	1.03 (0.4-2.4)	27	265	4.1 (1.7-10)
	Repetitive movements of the wrists			**Feel job too hectic/fast**			**Feel job is boring/monotonous**			**Job causes stress/worry**		
	Forearm pain at follow-up			Forearm pain at follow-up			Forearm pain at follow-up			Forearm pain at follow-up		
	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)
Never	5	198	1.0	5	153	1.0	10	323	1.0	2	100	1.0
Occasionally	8	222	1.4 (0.4-4.2)	22	351	1.9 (0.7-5.0)	25	327	2.4 (1.2-5.0)	23	377	3.1 (0.7-13.1)
Half/most of the time	29	319	3.4 (1.3-8.7)	15	237	2.0 (0.7-5.6)	7	90	2.5 (0.95-6.6)	17	264	3.3 (0.7-14.2)
	Satisfied with support from supervisor/colleagues			**Feel can learn new things**			**Feel can make own decisions**			**Feel satisfied with job**		
	Forearm pain at follow-up			Forearm pain at follow-up			Forearm pain at follow-up			Forearm pain at follow-up		
	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)	Yes	No	RR (95%CI)
Most of the time	10	376	1.0	10	203	1.0	26	517	1.0	26	498	1.0
Half of the time	10	186	2.1 (0.9-5.1)	3	192	0.3 (0.09-1.2)	7	135	1.03 (0.4-2.4)	12	163	1.4 (0.7-2.8)
Occasionally/never	20	153	4.7 (2.2-10)	29	343	1.6 (0.8-3.3)	9	88	2.0 (0.9-4.2)	4	78	1.02 (0.4-3.0)

Table 13. **Risk of forearm pain at follow-up: occupational mechanical and psychosocial exposures**

All RR are adjusted for age-group and gender

Exposure	RR	95% CI
Repetitive movement of arms		
Never	1.0	Reference
Occasionally	1.2	0.4-3.7
Half/most the time	2.9	1.2-7.3
Satisfied with support from supervisor/colleagues		
Most of the time	1.0	Reference
Half of the time	1.6	0.7-3.9
Occasionally/never	2.6	1.1-5.8
Illness behaviour score		
0-3	1.0	Reference
4-7	6.6	1.5-29
8-24	6.6	1.5-29
General Health Questionnaire score		
0	1.0	Reference
1-2	1.9	0.8-4.5
3+	1.8	0.8-4.1

Table 14. **Combined regression model of exposures for new onset of forearm pain**

Factor		Non participants (N = 297)		Participants (N = 1404)		*P* Value
Demographics		n	(%)	n	(%)	
Age (years)	18-34	147	(49)	420	(30)	
	35-49	73	(25)	565	(40)	
	50-64	77	(26)	419	(30)	0.000
Gender	Female	158	(53)	796	(57)	0.43
Psychosocial scales	Range	Median	IQR	Median	IQR	
General Health Questionnaire	0-12	0	0-3	0	0-3	0.20
Somatic symptoms	0-5	0	0-1	0	0-1	0.84
Fatigue	0-11	0	0-2	0	0-2	0.52
Health Anxiety	0-44	8	4-13	12	8-16	0.24
Illness Behaviour	0-24	5	3-9	5	3-8	0.18

All *P* values were by Mann-Whitney U test except those for age and gender, which were by chi-square test

Table 15. **Chronic Widespread Pain: Distribution of age, gender and psychosocial scale scores of participants and non participants.**

	Gender		
	Male	Female	All subjects
Number in group	608	796	1404
Number with new chronic widespread pain	27	54	81
Prevalence (%) (95% CI)	4.4 (2.8-6.1)	6.8 (5.0-8.5)	5.8 (4.5-6.9)

Table 16. **Prevalence of new chronic widespread pain at follow up by gender.**

	Age (years)			
	18-34	35-49	60-64	All subjects
Number in group	399	534	390	1404
Number with new chronic widespread pain	21	31	29	81
Prevalence (%) (95% CI) *	5.0 (2.9-7.1)	5.5 (3.6-7.4)	6.9 (4.5-9.3)	5.8 (4.5-6.9)

Table 17. Prevalence of new chronic widespread pain at follow up by age.

Exposure	Range	N	N with new CWP	Univariate model		Multivariate model	
				OR*	95% CI	OR*	95% CI
'Illness Behaviour'	0-4	450	6	1		1	
	5-7	546	30	4.2	1.7-10.1	4.3	1.8-10.7
	8-24	408	45	8.7	3.6-20.7	9.0	3.7-22.2
Somatic symptoms	0-2	1353	72	1		1	
	3-5	51	9	3.8	1.7-8.2	3.3	1.5-7.4
GHQ	0	712	39	1		1	
	1	158	13	1.6	0.8-3.0	1.0	0.5-2.1
	2-5	264	11	0.8	0.4-1.5	0.5	0.2-1.0
	6-12	189	18	2.0	1.1-3.7	0.9	0.4-2.0
Fatigue	0	847	39	1		1	
	1-2	188	16	1.8	1.0-3.2	1.7	0.9-3.3
	3-5	158	15	2.1	1.1-3.9	1.7	0.8-3.4
	6-11	130	11	1.8	0.9-3.6	1.1	0.5-2.5
'Health Anxiety'	0-5	520	25	1		1	
	6-11	469	26	1.1	0.6-2.0	0.8	0.5-1.5
	12-44	415	30	1.5	0.8-2.5	0.9	0.5-1.7

N = total group size
*Odds ratio of having new chronic widespread pain by scale score, age and gender adjusted

Table 18. **Predictors of new chronic widespread pain at follow up.**

Somatic symptoms score	Illness Behaviour score								
	0-4			5-7			8-24		
	N	n with new CWP	%	N	n with new CWP	%	N	n with new CWP	%
0-2	440	6	1.4	529	26	5.0	384	40	10.4
3-5	10	0	0	17	4	24.0	24	5	21.0

N = total group size
CWP=Chronic Widespread Pain

Table 19. Prevalence of new chronic widespread pain at follow up by baseline "Somatic Symptom Checklist" and "Illness Behaviour" scale scores

Characteristics at baseline		N	(%)*	OR**	95% CI
Age (years)	18-34	15	(16)	1.0	-
	35-45	23	(25)	2.6	(0.7-10)
	46-59	28	(30)	2.7	(0.7-9.9)
	60-74	26	(28)	3.2	(0.8-12)
Sex	Male	38	(41)	1.0	-
	Female	54	(59)	1.1	(0.5-2.6)
*Area of Pain****					
	Upper trunk/neck and shoulder specific pain	72	(78)	1.0	-
	Upper trunk/neck only	17	(18)	0.5	(0.2-1.6)
Pain on day of interview/examination					
	No	30	(33)	1.0	-
	Yes	62	(67)	3.8	(1.4-9.8)
Onset	Gradual	25	(27)	1.0	-
	Sudden	56	(61)	0.9	(0.3-2.5)
Time of onset	< 1 month	8	(9)	1.0	-
	1month-1year	14	(15)	1.3	(0.2-7.9)
	1 year	55	(60)	2.9	(0.6-14)
Attended GP	No	51	(55)	1.0	-
	Yes	34	(37)	2.8	(1.0-7.6)
GHQ score	0-1	49	(53)	1.0	-
	2-4	18	(20)	0.8	(0.3-2.7)
	5 or more	25	(27)	2.6	(0.8-7.7)
No. of restricted shoulder movements					
	0	23	(25)	1.0	-
	1	19	(21)	0.7	(0.2-2.4)
	2 or more	50	(54)	1.4	(0.5-4.2)
No. of shoulder related disabilities					
	0	54	(59)	1.0	-
	1-4	17	(18)	1.7	(0.5-5.3)
	5 or more	21	(23)	5.5	(1.6-19)

Table 20. Predictors of continuing shoulder pain: Univariate Analysis

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* Percentages may not total 100% due to missing data

** Odds ratio (relative to baseline category) of shoulder pain at follow-up, adjusted where appropriate for age and sex

*** 3 subjects did not report pain on baseline mailed questionnaire, only on the day of interview/examination

	Follow up Pain Status			
Initial Pain Status	No Pain (%)	Regional Pain (%)	Chronic WP (%)	Total (%)
Pain	23 (70)	10 (30)	0 (0)	33 (100)
Regional Pain	12 (16)	48 (65)	14 (19)	74 (100)
Chronic WP	5 (15)	17 (50)	12 (35)	34 (100)
Total	40	75	26	141

WP: widespread pain

Table 21. **Chronic Widespread Pain: Change in pain status between initial assessment and follow-up**

	Chronic WP Symptoms		
Characteristic*	Improved	No Improved	OR (95% CI)**
Sex			
Male	6	1	1.0
Female	16	11	4.1 (0.4, 39)
Age (years)			
24 – 46	8	1	1.0
47 – 61	9	4	3.6 (0.3, 39)
62 – 74	5	7	11 (1.0, 120)
Age left school (years)			
Before 16	7	8	1.0
16 or older	15	2	0.1 (0.01, 1.4)

Table 22. **Demographic variables and their association with chronicity of widespread pain symptoms**

---

* Measured at initial assessment

** Odds of persons with specific characteristics still having chronic widespread pain at follow-up relative to reference group. Odds ratios (OR) are adjusted for age-group and sex

	Chronic WP Symptoms		
Characteristic*	Improved	Not Improved	OR (95% CI)**
Tender point count			
< 11 tender points	16	3	1.0
≥ 11 tender points	6	9	5.1 (0.9, 28)
GHQ score			
12 – 19	7	2	1.0
20 – 24	5	3	2.6 (0.3,26)
25 – 28	9	5	3.8 (0.4,33)
HFQ score			
≥ 27	7	1	1.0
> 27	14	9	4.6 (0.4, 58)
*Additional symptoms?****			
No	4	0	1.0
Yes	18	12	∞
Trouble falling asleep?			
No	5	1	1.0
Yes	17	11	14 (1.8,120)
Trouble staying asleep			
No	7	1	1.0
Yes	15	11	16 (1.1,220)

Table 23. **Physical and psychological and their association with chronicity of widespread pain symptoms**

---

* Measured at initial assessment

** Odds of persons with specific characteristics still having chronic wide-spread pain at follow-up relative to reference group. All odds ratios (OR) are adjusted for sex and age group.

*** Micturition problems and/or abdominal pain and/or headaches

Recruitment Characteristics		Males			Females		
		N (=99)[*]	OR[#]	95%C.I.	N (=147)[*]	OR[#]	95% C.I.
Age (years)							
	18-38	29	1.0		52	1.0	
	39-53	34	0.4	(0.1, 1.5)	50	1.0	(0.5, 2.3)
	54-75	36	0.5	(0.2, 1.8)	45	1.8	(0.7, 4.3)
Self-rated health							
	Fair/Poor	36	1.0		60	1.0	
	Excellent/good	63	2.1	(0.8, 5.4)	87	0.8	(0.4, 1.6)
BMI (kgs/m^2)	<23.3	30	1.0		41	1.0	
	23.3 - 26.3	32	1.5	(0.5, 4.5)	53	1.7	(0.7,4.1)
	>26.3	35	1.8	(0.6, 5.7)	51	1.8	(0.8, 4.6)
Weight (kgs)	<72	38	1.0		50	1.0	
	72-83	29	3.5	(1.0, 13)	41	1.6	(0.6, 3.9)
	>83	30	1.4	(0.5, 4.0)	55	2.5	(1.1, 5.9)
GHQ score	22-48	55	1.0		100	1.0	
	12-22	42	8.7	(2.3, 33)	41	1.2	(0.5, 2.6)
Employment Status							
	Working	59	1.0		73	1.0	
	Not working	40	0.3	(0.1,0.8)	74	0.7	(0.3, 1.5)
Satisfied with work status[^]							
	No	51	1.0		78	1.0	
	Yes	47	3.5	(1.2, 10)	69	1.5	(0.7, 3.1)
Physical Activity[+]							
	Less active	22	1.0		39	1.0	
	Same/more active	76	3.2	(1.1, 8.8)	105	1.2	(0.5, 2.6)
Smoking	Never smoker	20	1.0		45	1.0	
	Ex-smoker	38	0.4	(0.1, 1.8)	38	0.6	(0.2, 1.6)
	Current smoker	41	0.2	(0.03,0.9)	64	0.5	(0.2, 1.3)

Table 24. **The association between pre-morbid factors and short-term improvement or resolution of low back pain symptoms.**

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[*] Numbers may not sum to total because of missing data

[#] Odds of improvement at 1-2 weeks post-consultation, relative to reference group

[^] Satisfaction with work status (i.e. being in employment, working at home, seeking work, off work due to ill-health or retired

[+] Physical activity in comparison to persons of the same age

Recruitment characteristic	Males N(=99)[*]	 OR[#]	 95% C.I.	Females N(=147)[*]	 OR[#]	 95% C.I
Duration of symptoms prior to consultation (weeks)						
> 4	20	1.0		43	1.0	
2-3	33	13.0	(3.3, 55)	42	2.5	(1.0,6.4)
0-1	46	13.0	(3.7, 45)	62	1.6	(0.7,3.8)
Symptom Onset						
Gradual	39	1.0		56	1.0	
Sudden	56	2.3	(0.9, 6.1)	88	0.5	(0.3, 1.2
Widespread pain[^]						
No	87	1.0		122	1.0	
Yes	12	0.2	(0.1, 0.7)	25	1.5	(0.5, 4.3
Pain in leg?						
No	46	1.0		52	1.0	
Yes	53	0.3	(0.1, 0.7)	95	1.2	(0.6, 2.4
Work related pain?						
Yes	59	1.0		51	1.0	
No	40	3.8	(1.3,11)	96	0.7	(0.3,1.5
Worst pain level (VAS Scale)						
<= Median	49	1.0		58	1.0	
> Median	49	0.9	(0.4, 2.3)	88	1.9	(0.9, 3.8

Table 25. The association between low back pain related factors and short-term improvement or resolution of low back pain symptoms.

---

[*] Numbers may not sum to total shown because of missing data

[#] Odds of improvement at 1-2 weeks post-consultation, relative to reference group

[^] Pain reported on a manikin, satisfying the American College of Rheumatology criteria for chronic widespread pain (Wolfe et al, 1990)

Pre-morbid and episode-related factors	OR[*]	95% CI
GHQ Score		
22-48	1.0	
12-21	8.8	(1.8, 43)
Symptom Onset		
Gradual	1.0	
Sudden	4.2	(1.1, 16)
Work related pain?		
Yes	1.0	
No	7.8	(1.7, 36)
Duration of Symptoms prior to Consultation		
> 4 weeks	1.0	
2-3 weeks	8.0	(1.5, 43)
0-1 week	7.0	(1.5, 34)

Table 26. **Predictors of early symptom improvement among males** (Pre-morbid and episode-related factors included in a stepwise logistic regression predicting short term outcome).

---

[*] Odds of early improvement in symptoms relative to reference group

Factors predicting improvement:	GHQ score >=22 Sudden onset of symptoms Symptoms not work-related Duration of symptoms <4 weeks prior to consultations

No. of factors present	No. with early improvement	No. of subjects	Observed proportion with early improvement
Four	11	11	1.00
Three	26	27	0.96
Two	29	36	0.81
One	4	15	0.27
None	1	4	0.25

Table 27. Early improvement in symptoms amongst males with low back pain

Characteristic	Person-years of follow-up	Deaths (N)	MRR (95% CI)*
Pain Status			
No Pain	19 368	196	1.00
Regional Pain	25 086	329	1.21 (1.01, 1.44)
Widespread Pain	7 942	129	1.31 (1.05, 1.65)
Age-Group (5-year bands)	-	-	1.68 (1.62, 1.75)
Gender			
Males	21 712	329	1.00
Females	30 684	325	0.63 (0.54, 0.74)

Table 28. Pain Status and subsequent mortality

---

* MRRs derived from multivariate regression model, adjusted for study location

Cause of Death	ICD-9 codes	No. deaths	MRR (95% Confidence Interval)*	
			Regional pain	Widespread pain
All Causes	001-999	654	1.21 (1.01,1.44)	1.31 (1.05,1.65)
All Cancers	140-208	201	1.55 (1.09,2.19)	2.07 (1.37,3.13)
Cardiovascular disease	390-459	261	1.14 (0.86, 1.49)	1.12 (0.78, 1.61)
Respiratory disease	460-519	106	1.00 (0.65, 1.53)	1.01 (0.57, 1.79)
Other disease-related	-^	72	1.36 (0.81, 2.29)	0.91 (0.45,1.85)
All external causes	800-999	14	3.01 (0.64,14.21)	5.21 (0.94,28.78)

Table 29. Pain status and subsequent mortality: specific causes of death

---

* Subjects classified as "No Pain" form the reference group; results adjusted for age, sex and study

^ All codes 001-799 excluding 390-519

	Person-years of follow-up	Deaths		
		N	Rate#	MRR (95% CI)^
No Pain	18 862	38	2.01	1.00
Regional Pain	24281	88	3.62	1.66 (1.13, 2.43)
Widespread Pain	7 588	42	5.54	2.27 (1.46, 3.54)

Table 30. **Pain Status and subsequent mortality from cancer** (in the sub-cohort free of cancer at the time of original survey)

\# per 1000 person-years
^ adjusted for age, sex and study location

	MRR (95% Confidence Interval)*	
Analysis adjusted for:	Regional Pain	Widespread Pain
Age, gender	1.40 (0.85, 2.33)	2.06 (1.15, 3.70)
+ current smoking status	1.39 (0.84, 2.30)	2.07 (1.15, 3.71)
+ level of psychological distress (GHQ score >= 1)	1.19 (0.71, 2.01)	1.91 (1.04, 3.49)

Table 31. Pain status and subsequent cancer mortality (Study A): in the sub-cohort free of cancer diagnosis at the time of original survey)

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* Subjects classified as "No Pain" form the reference

			MRR (95% Confidence Interval)*
Cancer Site	ICD+- codes	No. deaths	Widespread pain
All cancers	140-208	168	2.07 (1.37, 3.13)
Upper GI^ tract	150-1	11	2.21 (0.43,11.31)
Lower GI^ tract	153-4	17	3.25 (0.75, 14.01)
Lung	162	51	3.09 (1.45, 6.62)
Female Breast	174	9	∞ (1.03, ∞)
Other	-$	80	1.63 (0.82, 3.24)

Table 32. **Pain status and subsequent cancer mortality : site specific analysis** (in the sub-cohort free of cancer diagnosis at the time of original survey)

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* Subjects classified as "No Pain" form the reference group; results adjusted for age, sex and study
+ International Classification of Disease, Injuries and Causes of Death
^ GI=Gastrointestinal
$ *All codes 140-208 excluding 150-1, 153-4,162 and 174*

	Males		Females	
	N*	%	N*	%
All-ages	835	71	1118	79
Age-group				
18-32 years	213	74	313	89
33-42 years	200	68	264	74
43-52 years	206	69	272	78
53-65 years	216	73	269	76

Table 33. Chronic Widespread Pain: Number of participants and participation rates by sex and age

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* The denominator has been adjusted for people who have moved or died.

	Males		Females	
	CWP N	Consulted %	CWP N	Consulted %
All-ages	88	69	164	73
Age-group				
18-32 years	10	80	26	46
33-42 years	16	50	29	69
43-52 years	27	59	50	78
53-65 years	35	83	59	83

Table 34. **Percentage of subjects who had consulted a general practitioner with chronic widespread pain (by age-group and sex)**

Appendix 2

Figures

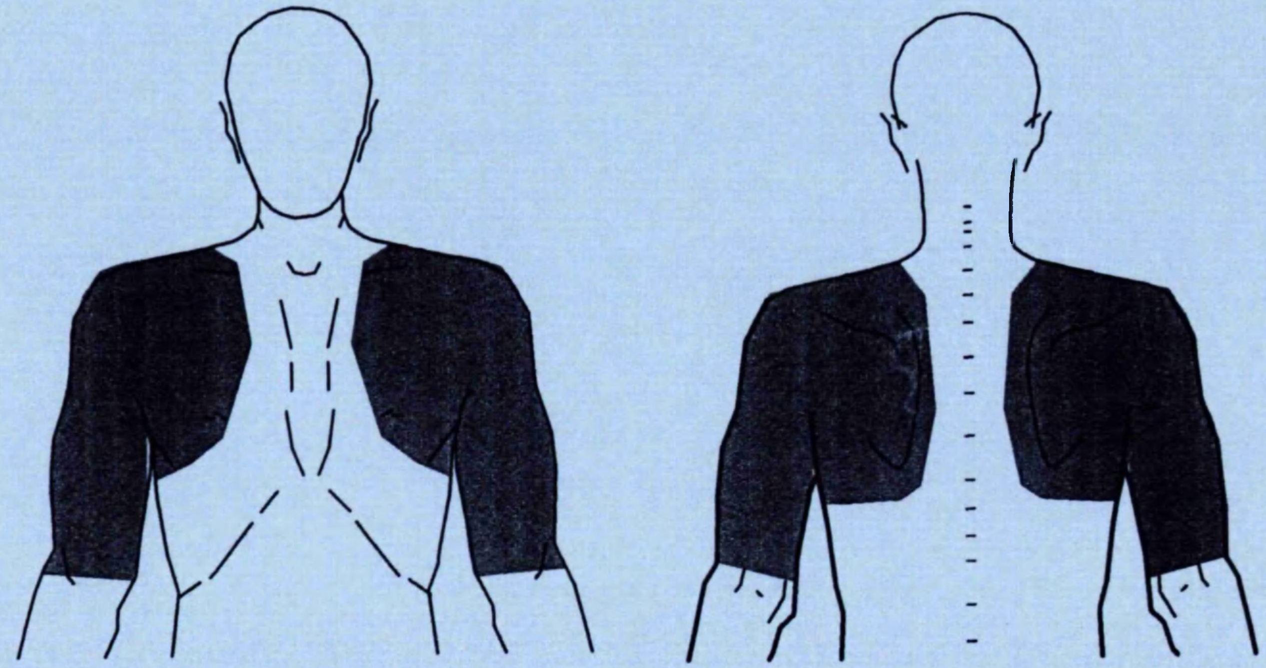
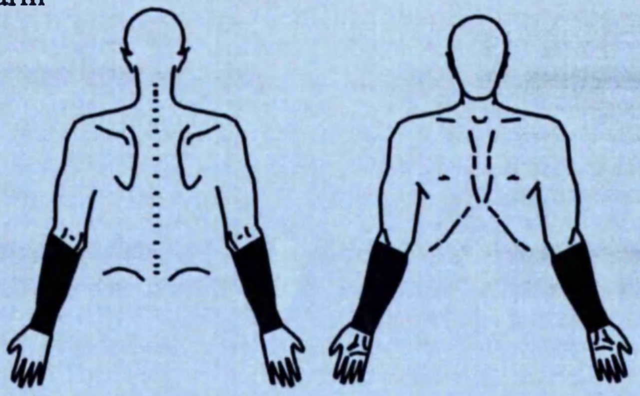
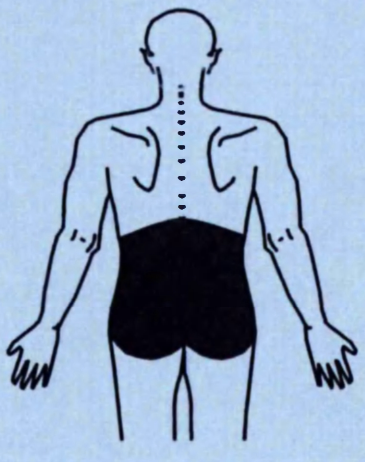


Figure 1: Anatomical area used in the definition of shoulder pain

a)
Forearm



b)
Low back



c)
Shoulder

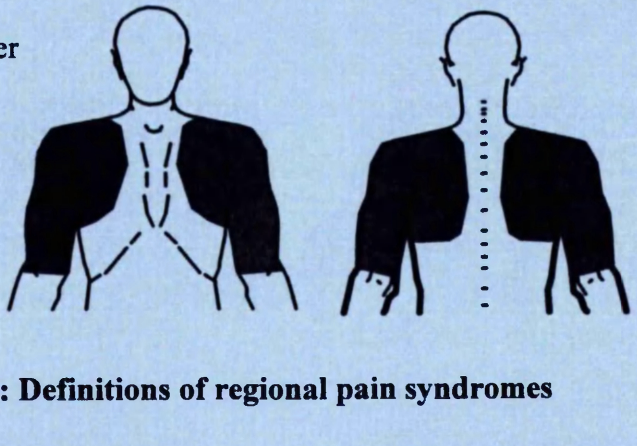
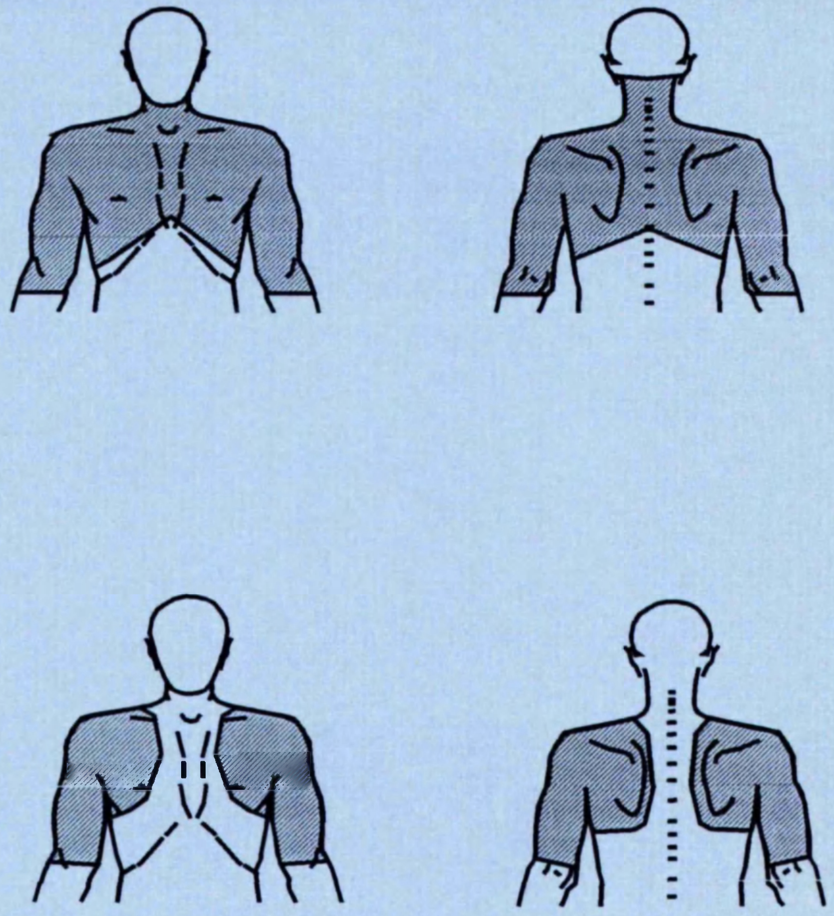


Figure 2: Definitions of regional pain syndromes

Figure 3: Anatomical areas used in the definition of shoulder pain



A: Upper trunk and neck area

B: Shoulder area

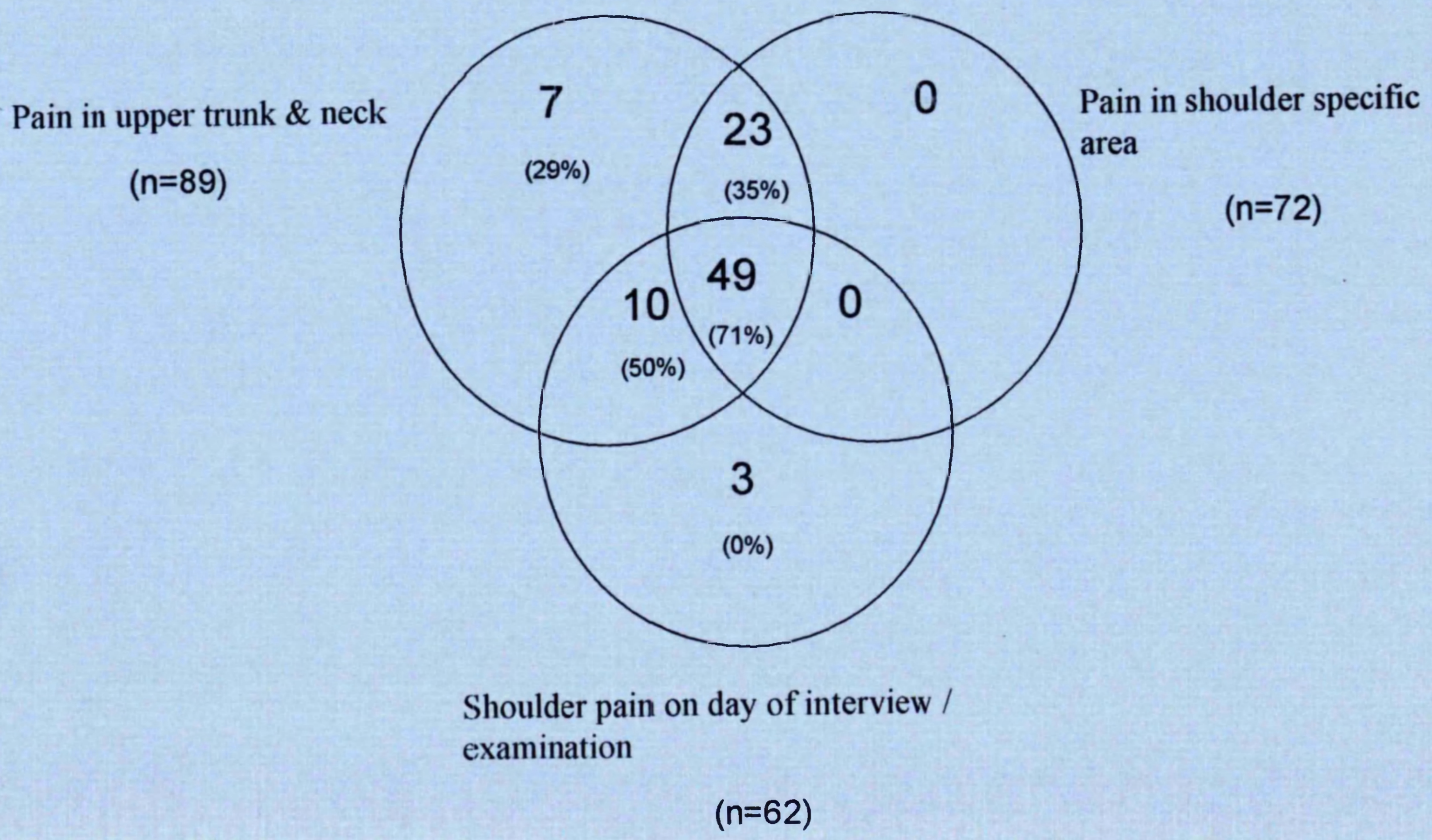


Figure 4: Distribution of pain at baseline by shoulder definition, and percentage of subjects with continued pain at follow-up

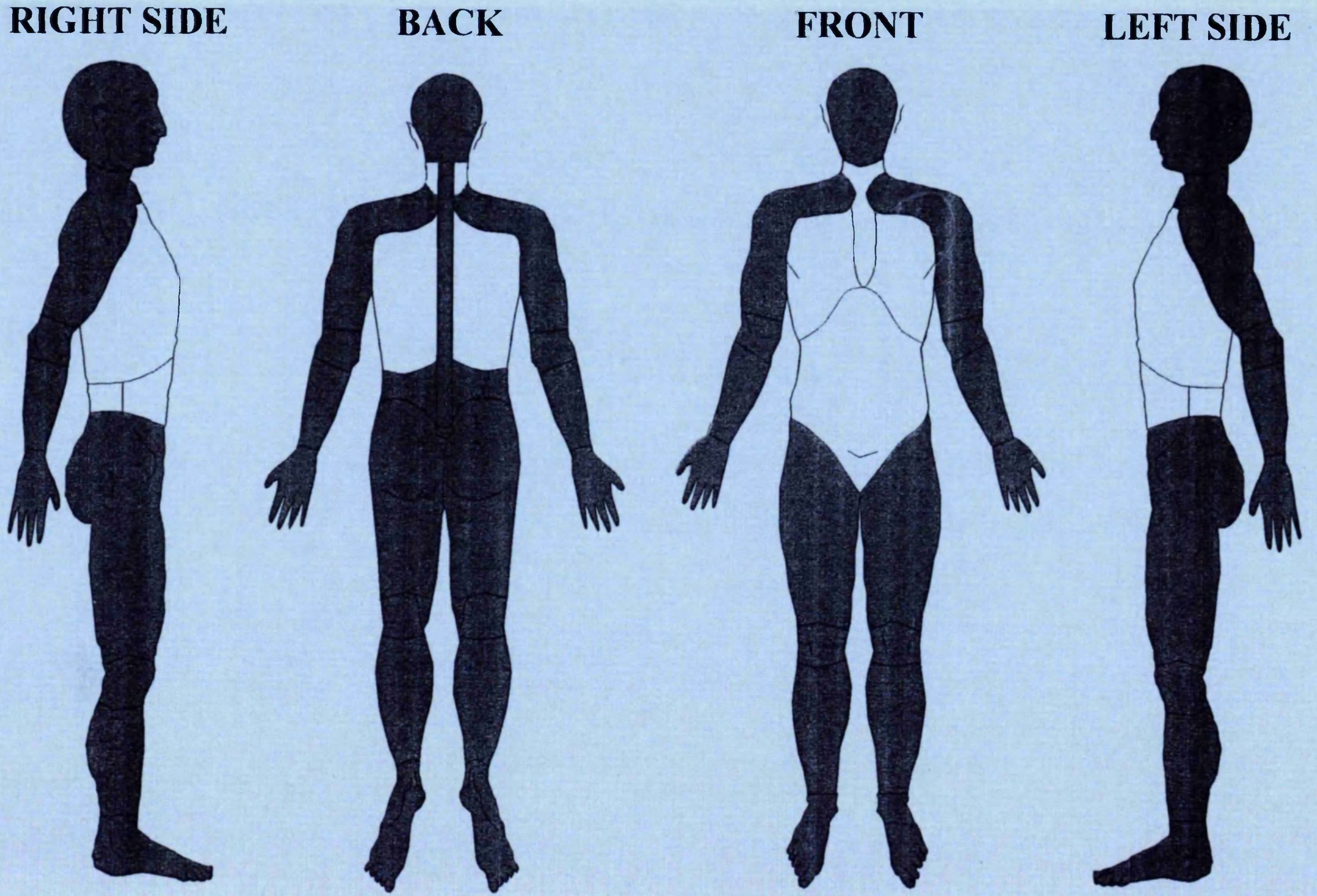


Figure 5. Coding scheme for the Manchester definition of chronic widespread pain, with areas used in the definition shaded grey

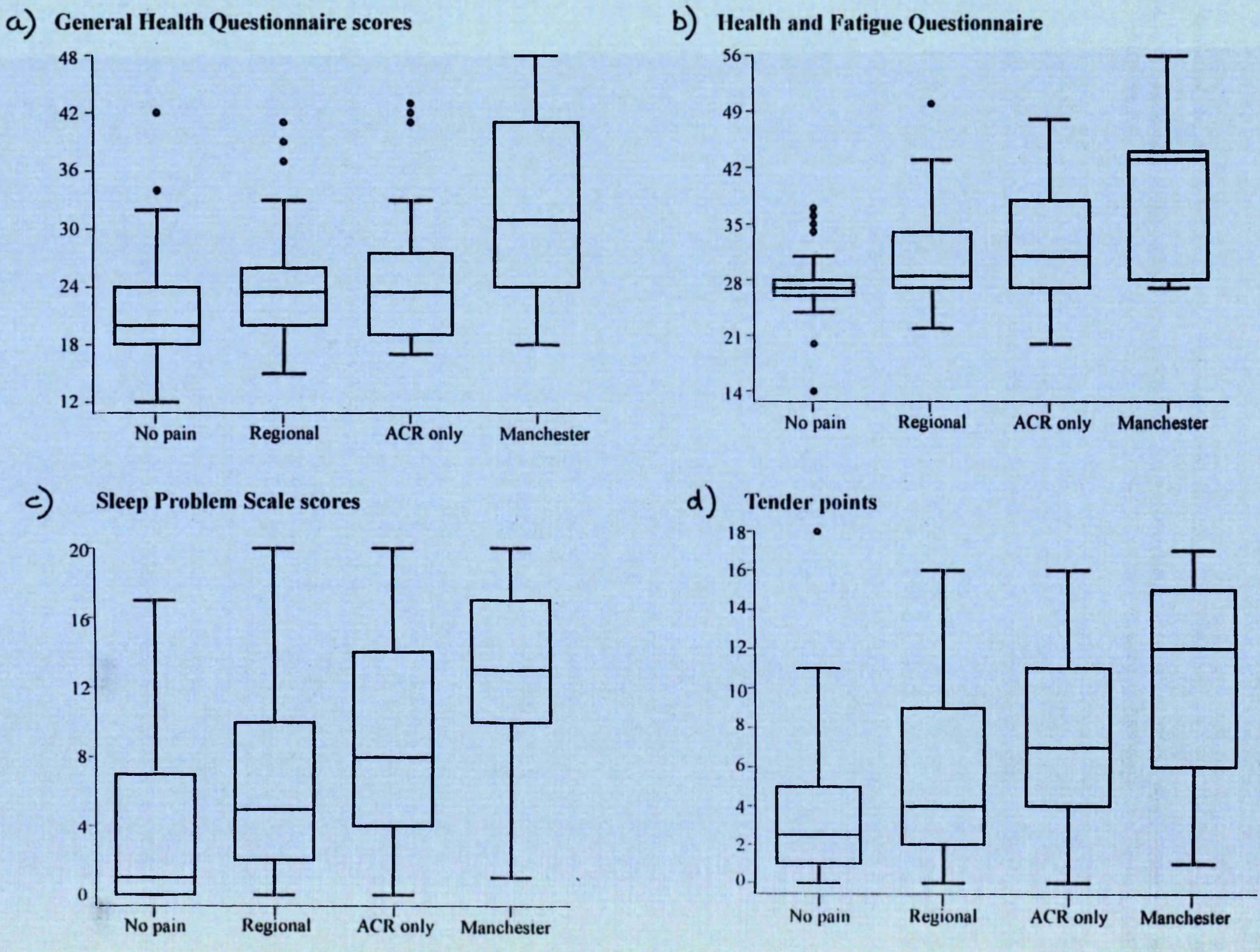


Figure 6: Associated features according to pain category (box-and-whisker plots)

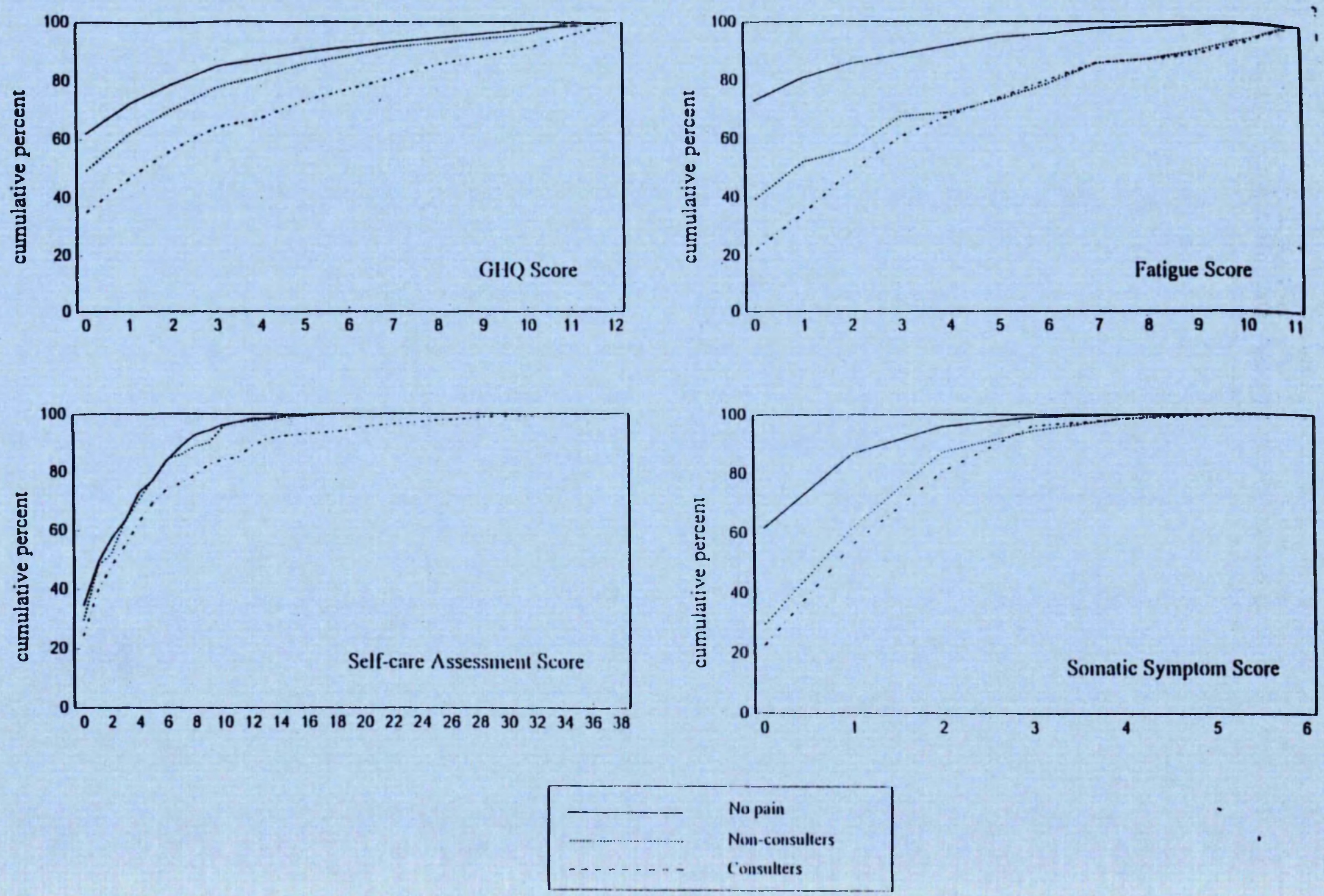


Figure 7: Cumulative distribution of scale scores for subjects with no pain, consulters and non-consulters with chronic widespread pain

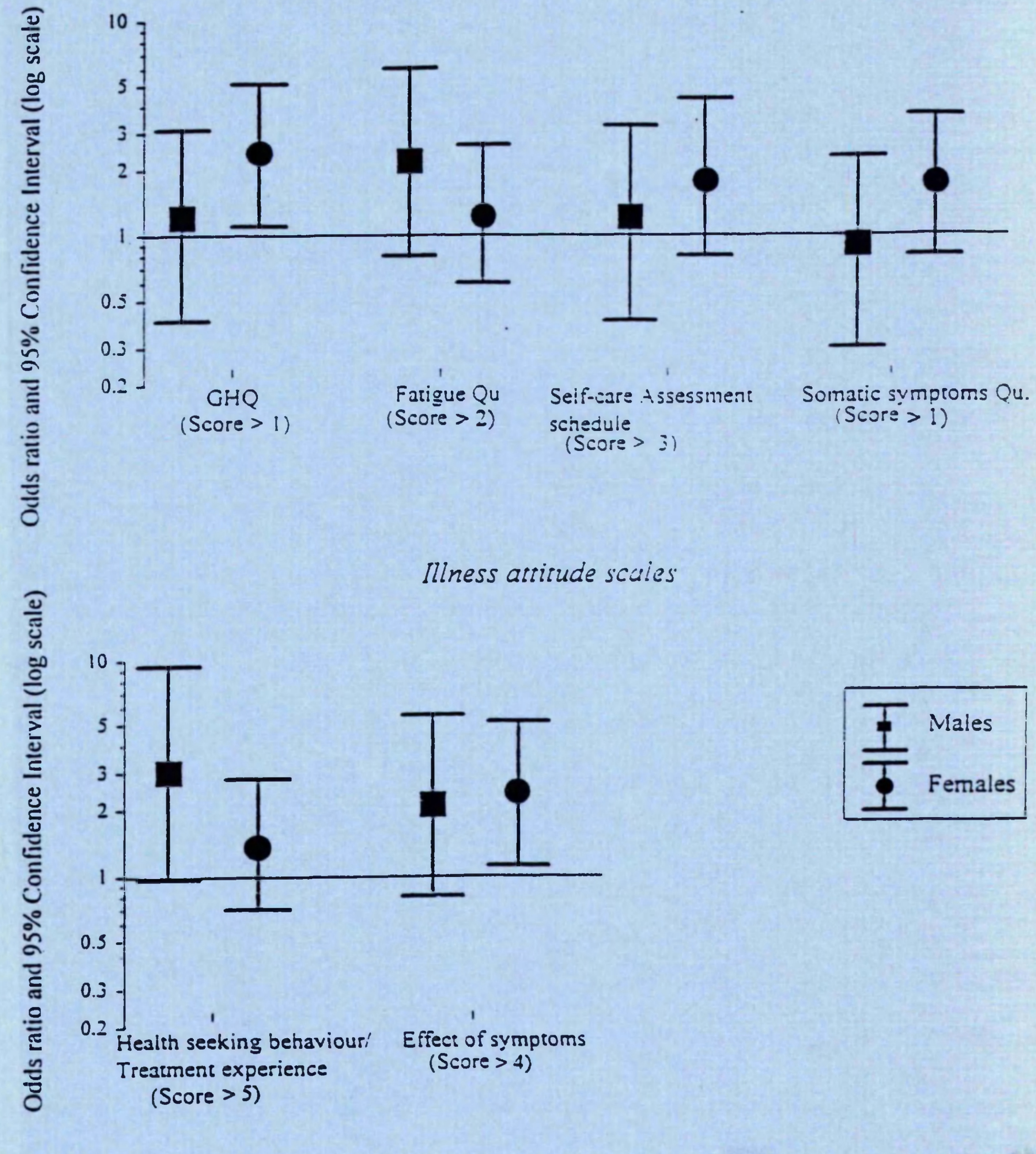


Figure 8: Factors associated with consultation among subjects with chronic widespread pain.

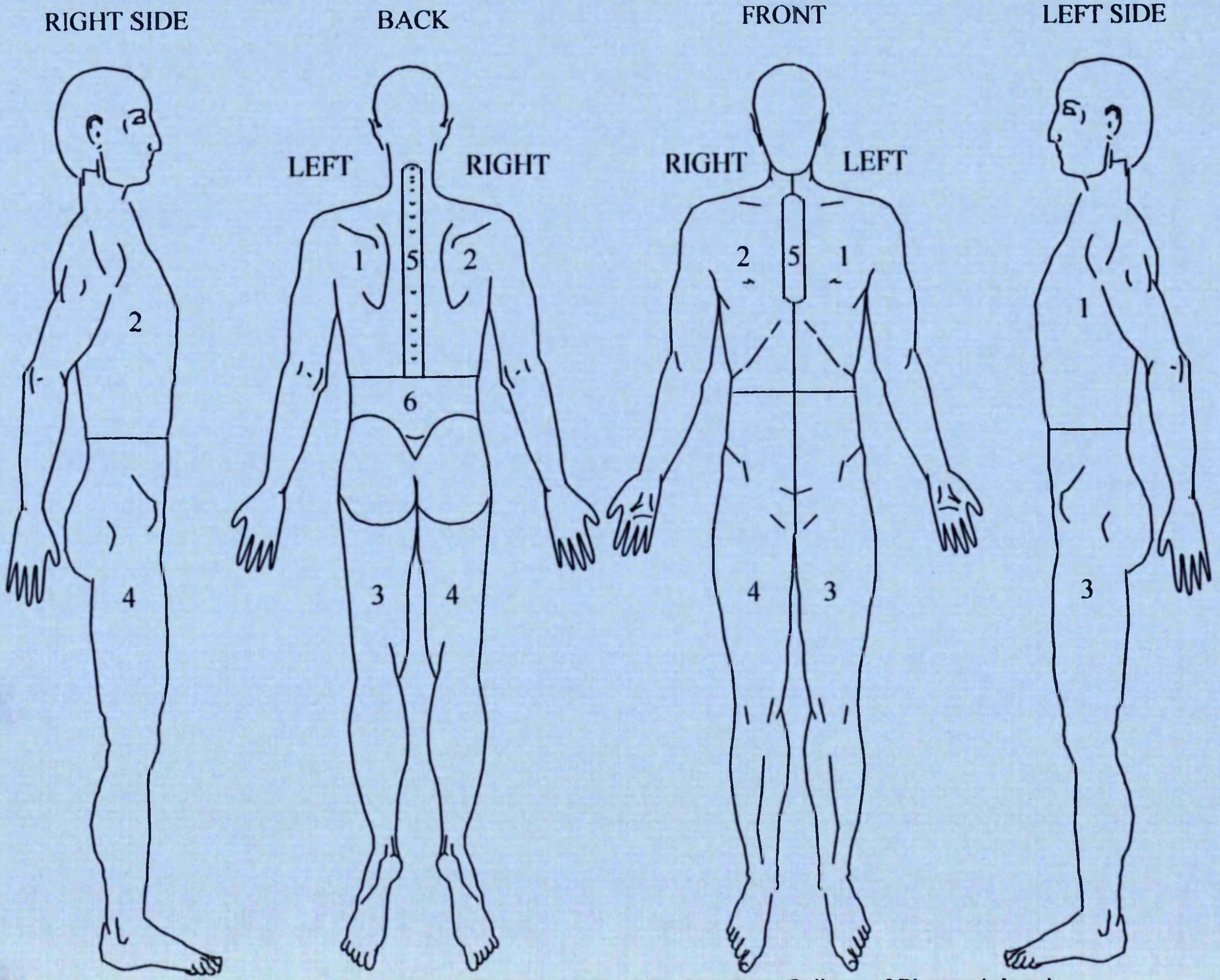


Figure 9: Body manikins (with coding schedule of the American College of Rheumatology)

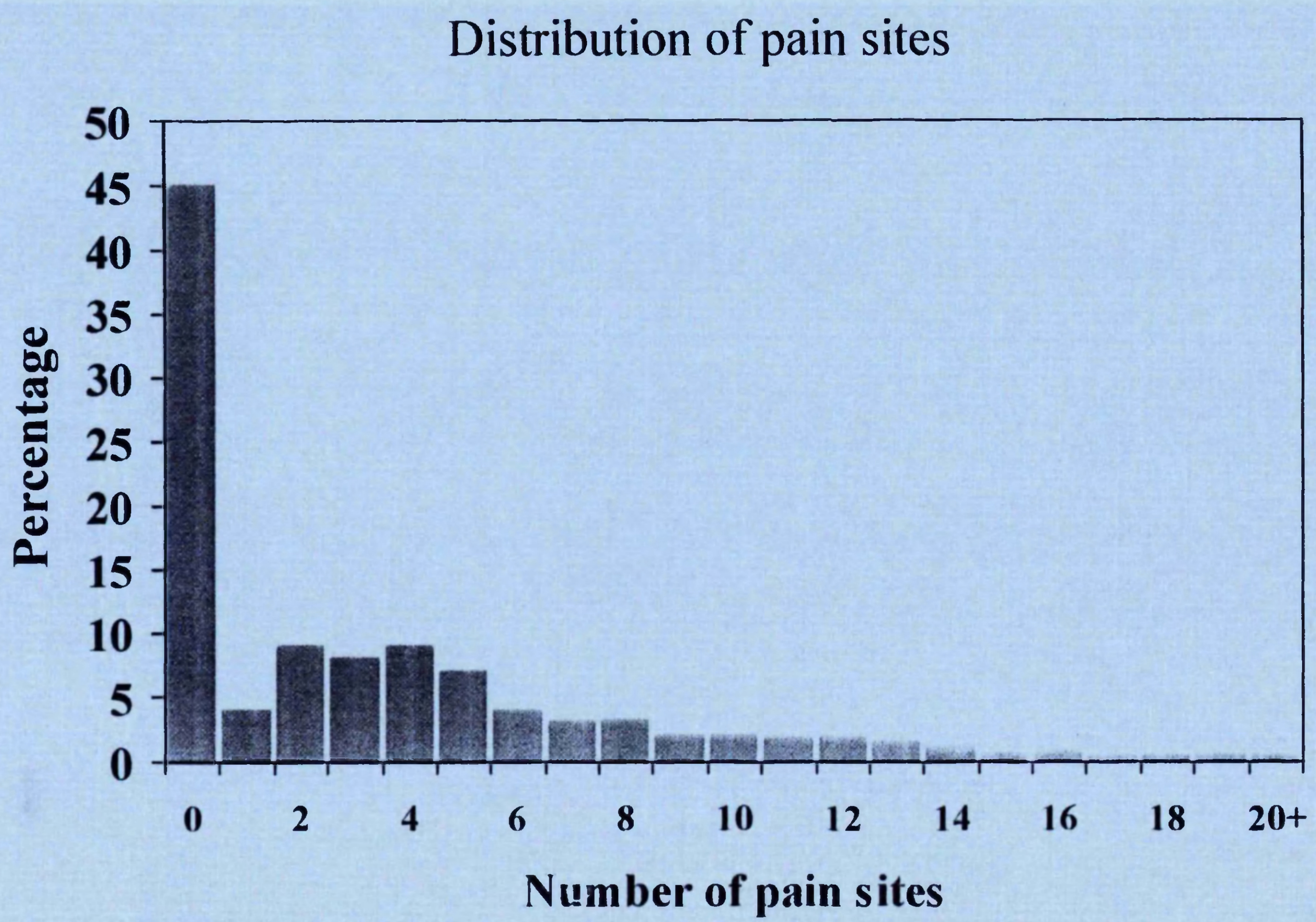


Figure 10: Distribution of number of regional pain sites reported in a population survey (Hunt et al, 1999)

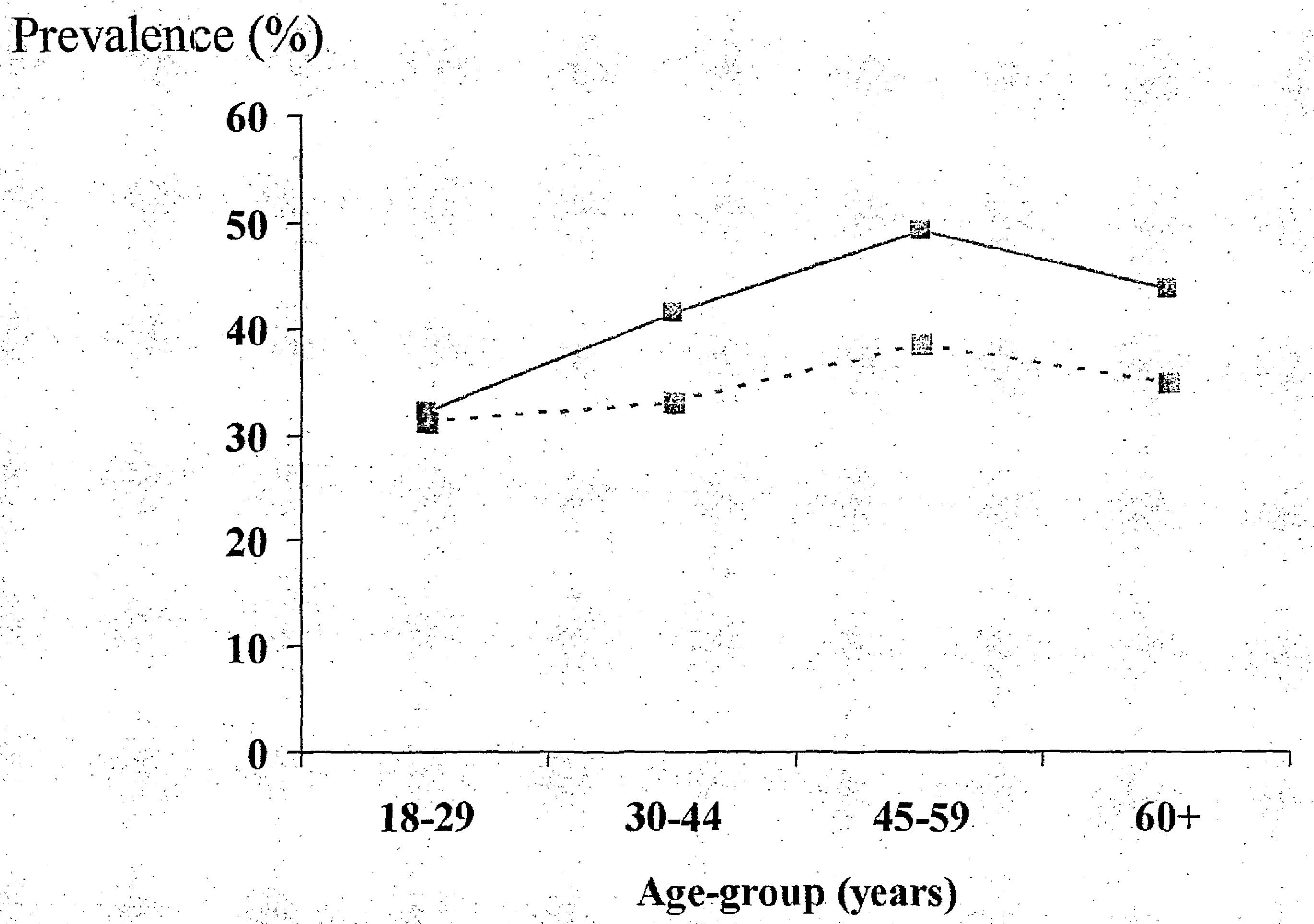


Figure 11a: The population prevalence of low back pain (female: solid lines, male: dashed lines) From Papageorgiou et al (1995)

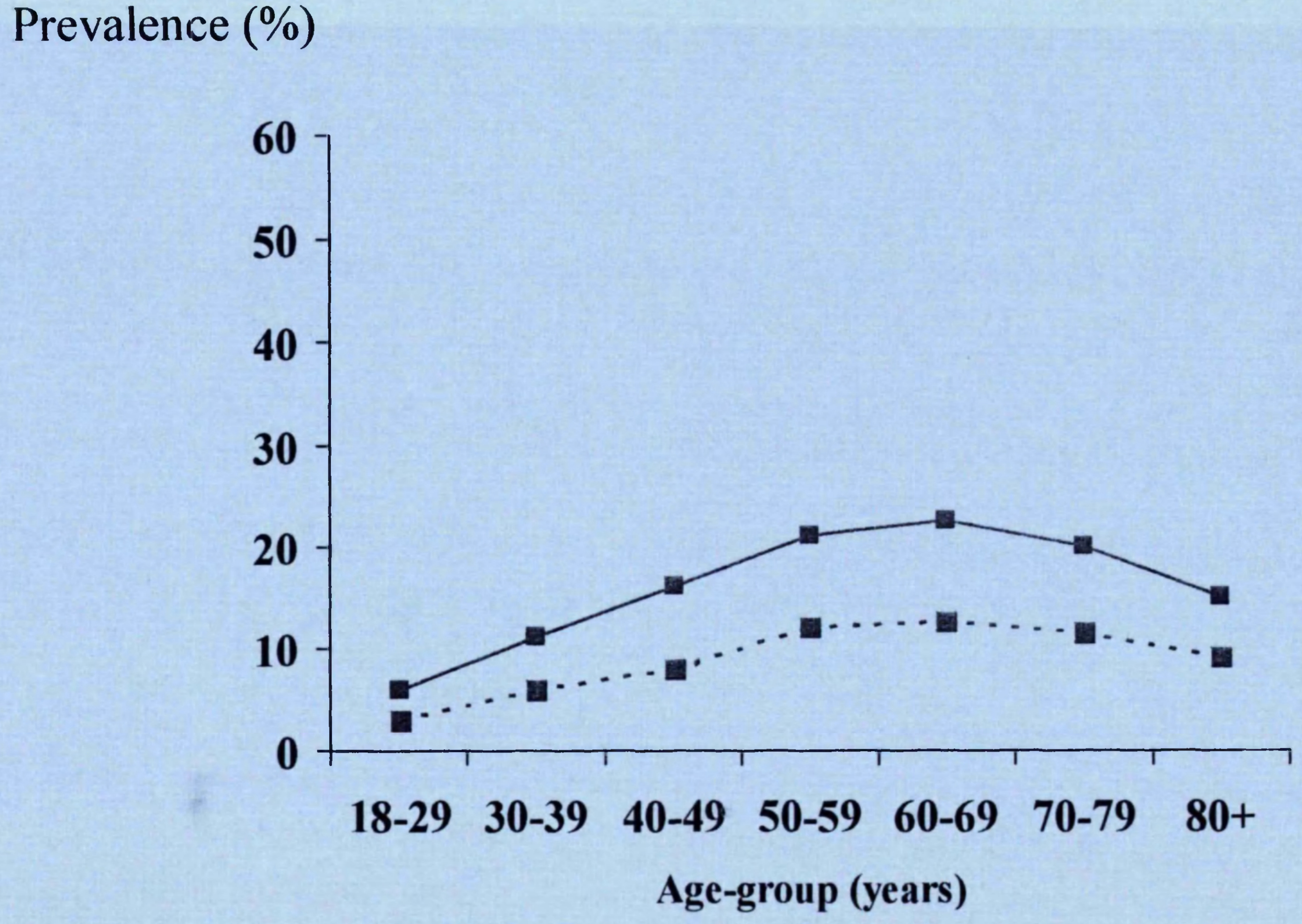


Figure 11b: The population prevalence of chronic widespread pain (female: solid lines, male: dashed lines) From Wolfe et al et al (1995)

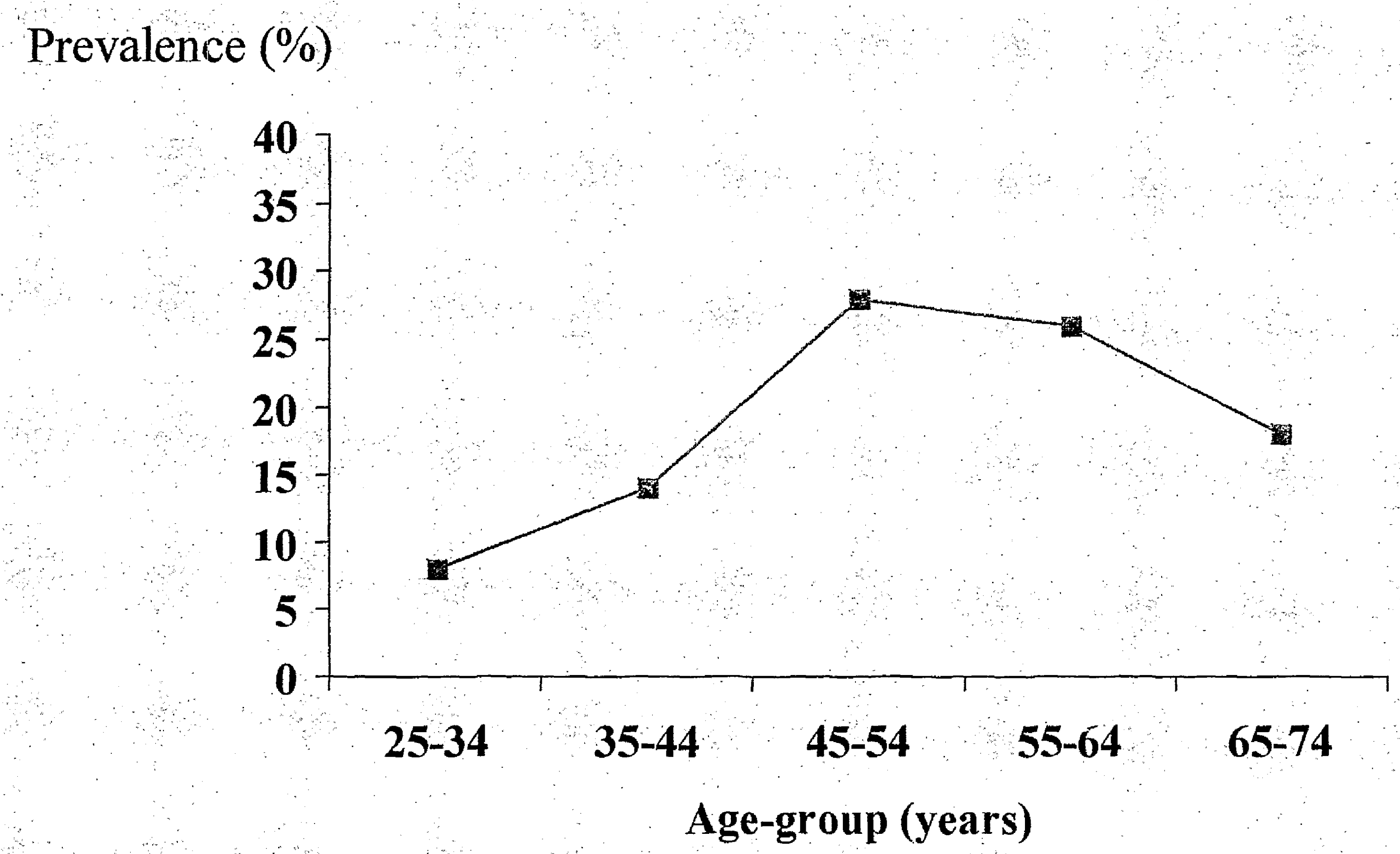


Figure 11c: The population prevalence of chronic shoulder/upper arm pain From Andersson et al (1993)

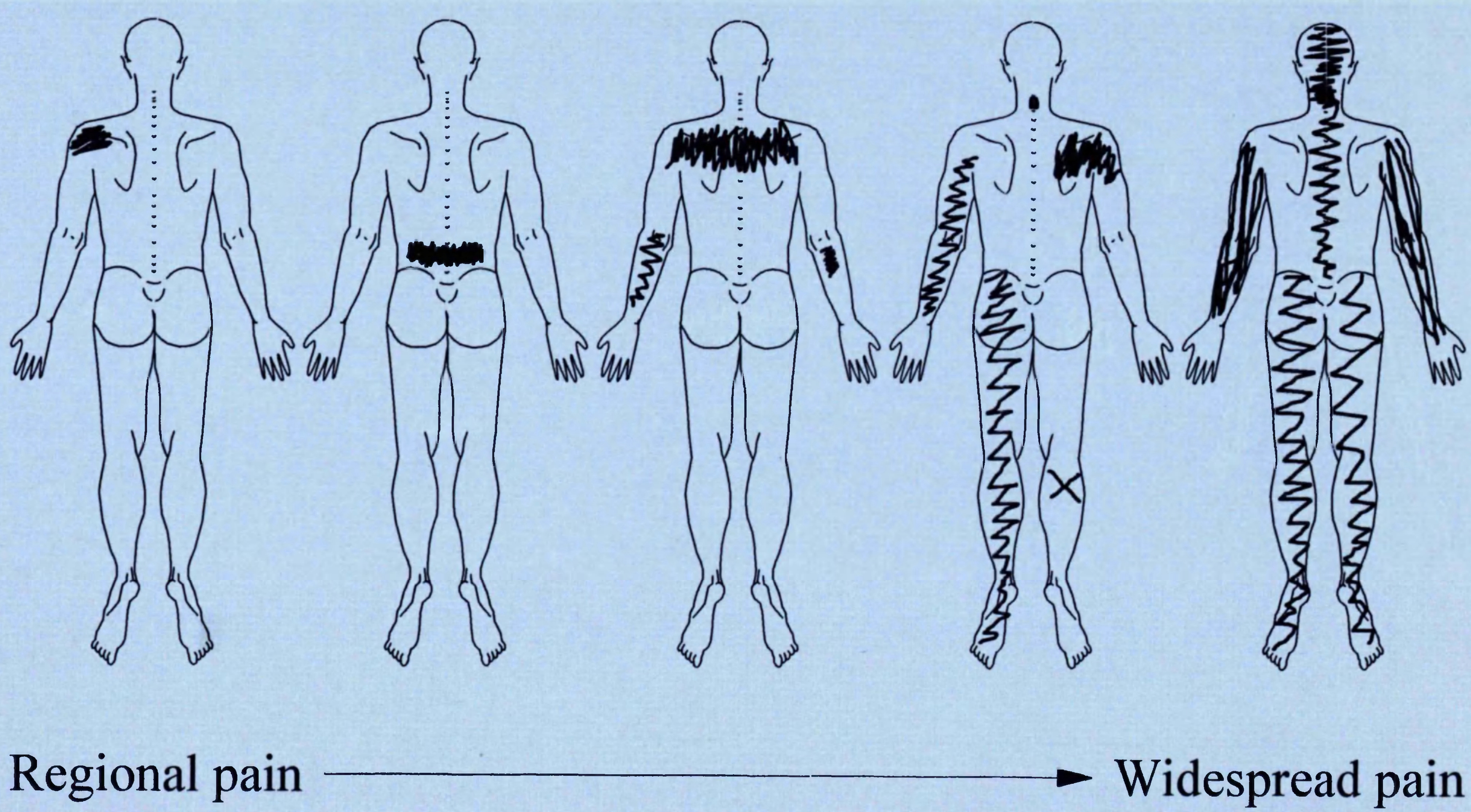


Figure 12: A continuum of pain