Shoulder pain in the community. An examination of associative factors using a longitudinal cohort study

TK Gill, EM Shanahan, AW Taylor, R Buchbinder, CL Hill

Contact author:

Tiffany K Gill

BAppSc, MAppSc, CertHealthEc, PGradDipHlthSc, MBA,

PGradDipBiostats, PhD

NHMRC Early Career Fellow

Discipline of Medicine

Faculty of Health Sciences

The University of Adelaide

Level 3, 122 Frome St

Adelaide, SA 5000

Phone: +61 8 83131206

Fax: +61 8 83131228

tiffany.gill@adelaide.edu.au

E Michael Shanahan BMBS, MPH, PhD, FRACP, FAFOEM

Rheumatologist and Occupational Physician

Southern Adelaide Health Service

Rheumatology Department

Repatriation General Hospital

Daws Rd, Daw Park SA, 5042

Associate Dean

School of Medicine

Flinders University, Bedford Park SA, 5041

Anne W Taylor BA, MPH, PhD

Associate Professor

Population Research and Outcome Studies

Discipline of Medicine

Faculty of Health Sciences

The University of Adelaide

Adelaide, SA 5005

Rachelle Buchbinder MBBS (Hons), MSc, PhD, FRACP

Rheumatologist and Director, Monash Department of Clinical Epidemiology, Cabrini Hospital; and Professor, Department of Epidemiology andPreventive Medicine, School of Public Health & Preventive Medicine, Monash University;

183 Wattletree Rd, Malvern Victoria 3144

Catherine L Hill MBBS, MD, MSc, FRACP

Staff Specialist, Rheumatology Unit

Rheumatology Department

The Queen Elizabeth Hospital

Woodville Rd, Woodville, SA 5011

Clinical Associate Professor

The Health Observatory

The Queen Elizabeth Hospital

The University of Adelaide, Adelaide, SA 5005

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Abstract

Objective: To determine factors that are predictive of incident, recurrent or resolved shoulder pain in a community based sample from the general population.

Methods: This study uses data from the North West Adelaide Health Study, a cohort study located in the northwestern suburbs of Adelaide, South Australia. Data were obtained between 2004-2006 and 2008-2010, time between measurements ranging from two to six years (median four years), using computer assisted telephone interviewing, clinical assessment and self completed questionnaire. Multivariate logistic regression was used to examine the factors associated with shoulder pain.

Results: Overall, 14.6% (95% CI 12.7-16.7) of 2337 eligible participants reported that they had developed (or had incident) shoulder pain between two time points of the cohort study, 8.8% (95% CI 7.5-10.3) reported recurrent shoulder pain and 8.7% (95% CI 7.0-10.6) had resolved shoulder pain. *Incident* shoulder pain was significantly associated with physically heavier occupational activities and pain in other joints after adjustment for age, sex and body mass index. *Recurrent* shoulder pain was also associated with pain in other joints but also with depressive symptoms, smoking and decreased shoulder range of movement. *Resolved* shoulder pain was associated with being female, other areas of pain, decreased shoulder range of movement but higher grip strength.

Conclusion: Different factors are associated with incident, resolved or recurrent shoulder pain in a longitudinal cohort study. Consideration of all of these factors may assist in the prevention and management of shoulder pain and the possible identification of those at risk of long term shoulder problems..

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Significance and Innovations

- Data from a longitudinal cohort study were used to determine the factors associated with incident, recurrent or resolved shoulder pain.
- Baseline decreased range of movement is significantly associated with recurrent and resolved shoulder pain but not incident shoulder pain.
- Pain in other joints is significantly associated with incident, recurrent and resolved shoulder pain.
- Occupational physical activity is significantly associated with incident shoulder pain.

Key words: pain, epidemiology, longitudinal studies, cohort study, population studies

Introduction

Shoulder pain is common within the population and may be long term and disabling (1). Pain may arise from a range of structures and conditions such as rotator cuff tendon problems, instability of the glenohumeral joint, adhesive capsulitis, synovitis and osteoarthritis (OA) of the acromioclavicular or glenohumeral joints (2). The prevalence of shoulder pain has been described by numerous studies and ranges widely. A cross-sectional study of the general population aged 30 years and over determined that the 30 day prevalence of shoulder pain in Finland was 16% (2), while shoulder pain among French male and female workers was 28.0% and 31.1% respectively (3). A systematic review of shoulder pain prevalence indicated that the one month and lifetime prevalence ranges between 18% and 31% and 6.7% and 66.7% respectively (4). In population studies conducted in South Australia, using this same cohort, 22.3% of participants reported that they had pain, aching or stiffness in either of their shoulders on most days for more than a month (5). However, variations in the prevalence of shoulder pain may be the result of case definition variations due to differences in the definition of pain location and duration (1, 2, 4).

The factors associated with shoulder pain have also been examined. Work-related shoulder problems have received a particular focus and repetitive work has been linked to upper limb disorders (6, 7) as have vibration, lifting heavy loads and working in awkward positions (7), and psychological and psychosocial factors (1, 8). Some studies have not found an association between shoulder pain and occupational physical activity with D'Onise et al reporting an association between shoulder pain and smoking, body mass index (BMI), low education levels and depression (9). In a narrative review, Shanahan and Sladek (10) concluded that although shoulder pain was common in the workplace, only a small proportion could be attributed to the work and often there is no readily identifiable cause. Other than work, several other factors have been associated with shoulder pain in population based studies. Hill et al (5) demonstrated that, women, those aged 50 years and over, those who were current smokers and those classified as obese were all significantly more likely to report shoulder pain. Rechardt et al (2) also demonstrated that smoking, high waist circumference and waist hip ratio were associated with shoulder pain in both males and females as were carotid intima media thickness, metabolic syndrome and type 2 diabetes in males and high levels of C-reactive protein in females. The association between chronic shoulder pain and psychological distress has also been examined in a community sample. Badcock et al (11) demonstrated anxiety and depression were correlated with severity of pain, but the relationship depended on the level of disability as measured by a shoulder disability questionnaire.

Studies determining the predictors of chronic shoulder pain in the community are, however, generally sparse. While some studies have examined the presence of shoulder pain over time, the majority have been cross-sectional in nature. The aim of this study was to determine factors that were predictive of incident, resolved or recurrent shoulder pain over time in a community based, population sample.

Materials and Methods

The North West Adelaide Health Study (NWAHS) is a representative longitudinal study of 4056 randomly selected adults aged 18 years and over at the time of recruitment from the north-west region of Adelaide, South Australia. The sample region represents approximately half of the metropolitan area (total population of approximately 1.2 million) and almost one-third of the population in South Australia (population of approximately 1.6 million), which has the second highest elderly population of all the Australian states and territories (12). The aim of the study is to provide longitudinal measured and self-reported data to assist in increasing the ability of strategies and policies to prevent, detect and manage a range of chronic conditions (13). The study commenced in 1999 to 2003 (Stage 1), Stage 2 was conducted between 2004 and 2006 and Stage 3 was conducted between 2008 and 2010.

Data collection

Subject information was obtained from a Computer Assisted Telephone Interview (CATI), a self-completed questionnaire and a clinic assessment at each stage (13, 14). A summary of major data items collected in each stage is provided in Figure 1. Of the original cohort of participants (n=4056), 3205 (81.5% of the eligible sample) participated in all three data collections, the CATI survey, self-complete questionnaire and clinic assessment, in Stage 2 and 2487 (67.0% of the eligible sample) completed these assessments in Stage 3 respectively. However, this analysis focuses on the 2337 participants who completed all of the relevant aspects in Stage 2 and 3.

Stage 1 variables

Information relating to main lifetime occupation was obtained from the Stage 1 telephone interview. The occupational physical activity was then estimated using this information. Each job title was rated by the level of physical activity and classified into sedentary, light, medium and heavy using the coding system of Ainsworth et al (15). Occupational titles that were not listed were rated using the same method by two occupational physicians independently. Differences in opinion on activity level were discussed and agreement reached by consensus (10).

Stage 2 variables

In Stage 2, smoking, physical activity, work status, education level and gross annual household income prior to tax were determined from responses to the self-completed questionnaire. The level of physical activity was determined from descriptions of physical activity type and time over a two week time frame (16). Depression was determined from the CATI response to the Centre for Epidemiological Studies in Epidemiology Depression questionnaire (CES-D) (17), and participants were asked if they been told by a doctor that they had arthritis. The presence of diabetes was determined from self-reported doctor diagnosed diabetes and/or a fasting plasma glucose level of greater than or equal to 7.0mmol/L. Participants were also asked as part of the CATI if they had ever had hip, knee, foot, hand and back pain and/or stiffness on most days for at least a month.

During the clinic assessment height and weight were measured with standardized protocols. A wall mounted stadiometer measured height to the nearest 0.5 centimetres and weight was measured using calibrated scales to the nearest 0.1 kilograms. BMI was then calculated (weight (kg)/height (m^2)) (18). Right and left shoulder flexion and abduction were measured using a Plurimeter V inclinometer and standardised protocols (19) and external rotation range was measured by observation. Visual observation of shoulder range of movement has been shown to have fair to good reliability and is comparable to goniometric measurements (20). All measurement training of clinical staff was also undertaken by a trained anthropometrist who ensured that all measurement techniques were appropriate. Grip strength was measured with a maximal voluntary contraction protocol using a Jamar® Analogue hand dynamometer. Three measurements were taken of each hand and the average recorded for each hand.

Shoulder pain and disability index (SPADI)

In Stage 3, participants who reported, as part of the CATI, that they had shoulder pain over the past month, on most days, and Stage 2 participants who had ever had shoulder pain on most days for at least a month were asked the SPADI, a thirteen item questionnaire which examines shoulder pain and disability across a variety of activities. The scores can be examined in terms of the pain and disability subscales and also as a total score. There are five items that comprise the pain score, eight items in the disability scale and thirteen items overall. Each scale can be converted to a percentage by adding the scores for each item, dividing by the maximum score possible and multiplied by 100. The higher the score, the greater the level of pain or disability. The intraclass correlation coefficient was shown to be 0.64 for the pain scale, 0.64 for the disability and 0.66 for the total score thus demonstrating an acceptable levels of test-retest reliability (21).

Data weighting

In Stage 1, data were weighted by region (western and northern health regions), age group, sex and probability of selection in the household to the Australian Bureau of Statistics 1999 Estimated Resident Population and the 2001 Census data to reflect the population of interest.

Stage 2 and 3 was reweighted using the 2004 and 2009 Estimated Resident Population for South Australia respectively, incorporating participation in the three components, whilst retaining the original weight from Stage 1 in the calculation. All analyses in this paper are weighted to the population of the northern and western suburbs of Adelaide. Ethics approval for the study was obtained from the Human Research Ethics committee of The Queen Elizabeth Hospital, Adelaide, South Australia and all participants provided written informed consent.

Statistical analyses

Statistical analyses were conducted using SPSS Version 19 (IBM SPSS Statistics, New York, NY, USA) and STATA version 12 (StataCorp, College Station, TX, USA). The first question of the SPADI (21), relating to pain severity, was used to define the groups of interest. This question asks "Thinking about the last week, please describe your pain on a scale from 0 to 10, (where 0 is no pain and 10 is the worst pain imaginable) at its worst". Those who provided a score of one or more were identified as those who currently had shoulder pain in each stage and this information was used to create the dependent variables of interest. Responses for those with shoulder pain in Stage 2 and Stage 3 were combined, as were those who did not have shoulder pain in Stage 2 but did have it in Stage 3 and those who had shoulder pain in Stage 2 but did not have it in Stage 3. A dichotomous dependent variable was created by comparing each of these groups to those without shoulder pain in Stage 2 and Stage 3. Frequencies of those without shoulder pain in Stage 2 and shoulder pain in Stage 3 (incident shoulder pain), those with shoulder pain in Stage 2 and Stage 3 (recurrent shoulder pain) and those with shoulder pain in Stage 2 but not in Stage 3 (resolved shoulder pain) were determined. A t-test was used to determine significant differences in the SPADI scores between those with recurrent and resolved shoulder pain. Univariate logistic regression analysis compared each shoulder pain group to those without shoulder pain, to determine the crude odds ratios for demographic and various associated factors. All variables were then included in multivariate logistic regression analysis and non-significant variables were removed in a backwards stepwise process to determine the factors ($p<0.05$) associated with incident, recurrent and resolved shoulder pain. A multivariate logistic regression model also compared those with recurrent shoulder pain to those with resolved shoulder pain. The multivariate models were controlled for age, sex and BMI and all models were tested for goodness of fit using the Hosmer and Lemeshow goodness-of-fit test. This statistic is chi square distributed and when the value of the chi square value is low the p-value is not significant indicating that the model is a good fit for the data (22).

Results

In Stage 2, the prevalence of ever having shoulder pain only was 21.4% (95% CI 19.3-23.6) and in Stage 3, the prevalence of current shoulder pain was 24.2% (95% CI 22.1-26.4). Overall, 2337 participants were involved in this analysis, having provided responses to the shoulder pain questions in both Stage 2 and Stage 3. Weighted analysis indicated that there was 14.6% (95% CI 12.7-16.7) who reported that they had incident shoulder pain (no pain in Stage 2 but pain in Stage 3), 8.8% (95% CI 7.5-10.3) reported recurrent shoulder pain (pain in Stage 2 and Stage 3) and 8.7% (95% CI 7.0-10.6) reported resolved shoulder pain (pain in Stage 2 but not in Stage 3) (Table 1).

Selected baseline characteristics of each group at Stage 2 of data collection, are reported in Table 2. There was a higher proportion of females in the resolved shoulder pain group compared to the other groups and a higher proportion of current smokers among those who had incident, and those who had recurrent shoulder pain. For the two groups that had shoulder pain at Stage 2, those with recurrent shoulder pain (i.e. also had pain in Stage 3) had higher pain, physical functioning and total scores as measured by the SPADI at Stage 2 than the resolved shoulder pain group (i.e. no pain in Stage 3) (Table 2). These scores were significantly higher ($t=3.14$, $p=0.002$ for pain score; $t=2.95$, $p=0.003$ for physical functioning score and $t=3.15$, $p=0.002$ for total score).

Incident shoulder pain compared to no shoulder pain

Multivariate logistic regression adjusted for age, sex and BMI demonstrated that occupational activities classified as medium or heavy at Stage 1 and back and foot pain at Stage 2 were all significantly associated with incident shoulder pain (Table 3). The Hosmer and Lemeshow goodness-of-fit test indicated that the model was a good fit for the data (χ^2 = 8.03, p=0.403, df=8).

Recurrent shoulder pain compared to no shoulder pain

Multivariate analysis demonstrated that current smoking, depressive symptoms, knee, hip, back and hand pain in Stage 2 were all significantly associated with recurrent shoulder pain. Those with higher ranges of shoulder flexion and shoulder abduction of their dominant shoulders, those who are retired and students were less likely to have recurrent shoulder pain (Table 4). The Hosmer and Lemeshow goodness-of-fit test indicated that the model was a good fit for the data (χ^2 = 9.68, p=0.2884, df=8).

Resolved shoulder pain compared to no shoulder pain

Multivariate analysis demonstrate that being female, having a higher grip strength in the dominant hand, knee, back and hand pain in Stage 2 were all significantly associated with resolved shoulder pain. Those with better ranges of shoulder abduction and external rotation of the dominant side at Stage 2 were less likely to report resolved shoulder pain (Table 5). Again, the Hosmer and Lemeshow goodness-of-fit test indicated that the model was a good fit for the data (χ^2 = 7.00, p=0.5367, df=8).

Recurrent shoulder pain compared to resolved shoulder pain

Finally, multivariate logistic regression was used to determine the characteristics associated with recurrent shoulder pain compared to resolved shoulder pain. When adjusted for sex, age and BMI, recurrent shoulder pain was associated with being a current smoker in Stage 2 and having knee pain. Females and those with higher non-dominant grip strength were significantly less likely to have recurrent shoulder pain. (Hosmer and Lemeshow goodness-of-fit test $\chi^2 = 14.57$, p=0.0681, df=8, data not shown).

Discussion

This study aimed to determine the factors which impacted on the presence of shoulder pain in a population based longitudinal study. While work related factors (6, 7, 8, 10) have been identified, other factors such as age, smoking and obesity have also previously been shown to be associated with shoulder pain (2, 5, 9).

Different factors impacted on the development of shoulder pain or whether pain was recurrent or had resolved. Occupational physical activity as determined at Stage 1 of testing was associated with incident shoulder pain. While D'Onise et al (9) did not find an association between occupational physical activity and shoulder pain, that study was cross-sectional in nature. A prospective study conducted by Miranda et al (7) demonstrated that occupational physical loading increased the risk of shoulder disorders however the study examined activities such as repetitive work, carrying heavy loads, vibration, working in awkward positions or work paced by a machine rather than the physical activity level associated with a job. Occupational physical activity level may provide a cumulative effect on the shoulder and as shown in this study, medium and heavy levels of activity are associated with shoulder pain in the long term.

Back and foot pain which were present at Stage 2 were also associated with incident shoulder pain. Oh et al (23) demonstrated that knee OA was associated with shoulder OA providing support to the notion that OA in one joint may predispose one to OA in another joint. While OA was not specifically examined, participants were able to report whether they had been told by a doctor that they had arthritis. Self-reported pain in a joint in the NWHAS may be due to arthritis and may also be present at multiple sites. Multiple joint problems have been shown to be more common than single joint problems (24). Kamaleri et al (25) demonstrated that health-related, lifestyle and demographic variables predicted the number of musculoskeletal pain sites at a 14 year follow up. These factors included: age, sex, education, general health, sleep quality, taking medication, psychological distress, family history of musculoskeletal problems and examination or treatment of musculoskeletal pain at baseline. However when the number of pain sites at initial assessment was added to the model, this was the single most important predictor of musculoskeletal pain at follow up (25). Hill et al (26) have also demonstrated that foot pain in the North West Adelaide cohort is also associated with reports of pain in other joints. Participants with recurrent shoulder pain had pain in multiple areas, as did those with resolved shoulder pain, which may indicate a burden of joint pain associated with recurrent shoulder pain or represent components of chronic widespread pain.

Those with higher grip strength at baseline were more likely to have resolved shoulder pain compared to those with no shoulder pain and also compared to those with recurrent shoulder pain. As summarized by Angst et al (27) grip strength is an important factor that predicts disability in musculoskeletal disease, bone mineral density, general disability and outcomes among older people. Higher grip strength at baseline may reduce the disability associated with shoulder pain and improve outcomes and resolution of pain.

In this study, both smoking and depression were independently associated with recurrent shoulder pain compared to those with no shoulder pain. Those who smoked in Stage 2 were more likely to report recurrent shoulder pain compared to those with resolved shoulder pain. Smokers are more likely to have chronic musculoskeletal conditions (28, 29) and those with chronic pain conditions have higher rates of smoking (30). Those with musculoskeletal conditions who smoke are more likely to report higher pain levels, pain interference with life and functional disability (29, 31, 32). Smoking cigarettes has been identified as a means of coping with chronic pain and Patterson et al (33) demonstrated that when smoking was identified as a coping strategy there was a significant association with fear of pain, pain intensity and pain interference. The association between pain and smoking may be caused by damage to the musculoskeletal elements due to hypoxia or vasoconstriction, or a lower pain tolerance which has occurred over the long term (34). Smokers may also be more likely not to exercise. Unpublished data from the NWAHS indicates that current smokers had lower levels of physical activity. This may confound the relationship with shoulder pain as smokers who are less fit may be more likely to injure themselves.

Smoking has also been associated with depression (32, 35, 36) however smoking does not cause depression (35, 36) and depression and anxiety have also been associated with pain in previous studies (37, 38, 39). Cho et al (40) have demonstrated that depression and anxiety are associated with shoulder pain which has been present for three months or more and Badcock et al (11) demonstrated that psychological factors associated with shoulder pain were influenced by disability. This study also demonstrated an association between depressive symptoms and decreased range of movement at Stage 2 and recurrent shoulder pain. Decreased range of movement may indicate a decreased ability to function, with depression and disability related to the recurrent experience of pain rather than the development of pain. This is further supported by Goesling et al (32) who determined that the association between smoking and pain severity and interference was mediated by depressive symptoms and it is the relationship between depressive symptoms and smoking and not smoking on its own that plays a role in self-reporting higher levels of pain, or perhaps recurrent pain.

Not surprisingly, those with higher ranges of movement at Stage 2 were less likely to report both recurrent and resolved shoulder pain as both of these variables were dependent on the presence of pain at Stage 2. Hill et al (5) previously demonstrated in a cross-sectional analysis of the same cohort described in this study that those with shoulder symptoms at Stage 2 had a reduction in shoulder range of movement for all movement when compared to asymptomatic participants. Those with recurrent pain also had lower SPADI scores, particularly in terms of physical function.

A limitation of this study is the non-specific questions regarding the presence of shoulder pain and also the lack of a specific diagnosis. However, it can be argued that symptoms (such as pain) do not necessarily match with pathology as previous studies have demonstrated the presence of shoulder pathology without symptoms (41, 42). Other limitations are that while the presence of pain has been identified at two time points there is an inability to determine whether pain is continuous between Stage 2 and 3 and there is also a lack of information relating to treatment and type of shoulder pain. The sample has also been obtained from the metropolitan area of a city in Australia, and thus the generalizabilty to other populations may be limited

A strength of this study is the use of a longitudinal cohort with questions relating to joint pain asked at two time points and with data available over a 6-7 year time period, as well as providing data on range of motion and grip strength. There are over 2000 participants who provided responses to the shoulder questions in Stage 2 and Stage 3 and a broad range of covariates available for analysis. To our knowledge there are no previous Australian longitudinal studies of shoulder pain from a population-based sample with the same breadth of covariates. A further strength of the study is the use of the SPADI which has been shown to have construct and criterion validity (21).

In conclusion, shoulder pain affects a significant proportion of the population over a period of time. Smoking, depression, reduced range of movement and pain at multiple sites are all associated with reports of recurrent shoulder pain. Multiple pain sites and occupation impact incident shoulder pain. Reduced range of movement and multiple pain sites are also associated with resolved shoulder pain, compared to those without pain. Smoking is a significant factor associated with recurrent shoulder pain compared to resolved shoulder pain. Attention to public health messages such as decreasing smoking as well as the importance of occupational health standards to prevent shoulder pain development are factors that may assist in the prevention and management of shoulder pain and the possible identification of those at risk of long term shoulder problems, as increased levels of shoulder pain place a significant and sustained burden on the health care system over time.

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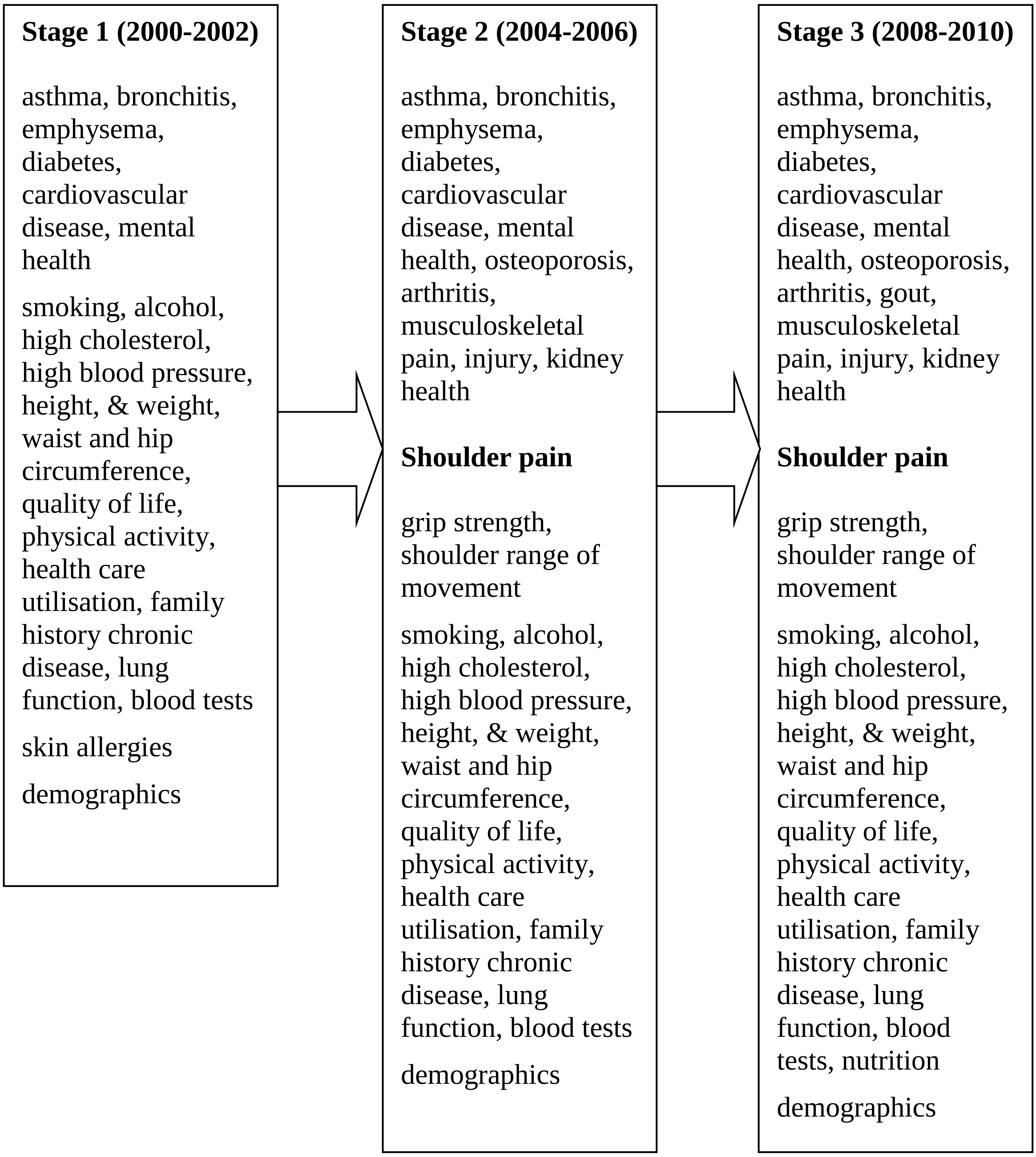
Figure 1: Summary of major data items, the North West Adelaide Health Study



Note: shoulder pain was not collected in Stage 1. Incident, recurrent and resolved shoulder pain were determined from responses in Stage 2 and 3.

Table 1: Proportion of participants who incident, had resolved or recurrent shoulder pain*

	n	% (95% CI)
No shoulder pain in Stage 2 or 3	1589	68.0 (65.3-70.5)
No shoulder pain in Stage 2, pain in Stage 3 (incident shoulder pain)	341	14.6 (12.7-16.7)
Shoulder pain in Stage 2 and Stage 3 (recurrent shoulder pain)	206	8.8 (7.5-10.3)
Shoulder pain in Stage 2 but not Stage 3 (resolved shoulder pain)	202	8.7 (7.0-10.6)
Total	2337	100.0

***The weighting of data can result in rounding discrepancies or totals not adding.

Table 2: Selected baseline characteristics (Stage 2) of each shoulder pain group

	No shoulder pain		Incident shoulder pain		Recurrent shoulder pain		Resolved shoulder pain	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Sex								
Male	819	51.6	168	49.4	92	44.7	71	35.3
Female	769	48.4	173	50.6	114	55.3	131	64.7
Work status*								
Full time	729	49.3	158	48.7	80	40.4	67	39.6
Part time	252	17.0	58	18.1	29	14.7	33	19.8
Unemployed	33	2.2	4	1.4	5	2.6	2	1.3
Home duties	162	10.9	34	10.6	26	13.3	26	15.5
Retired	236	16.0	53	16.4	45	23.1	35	20.6
Student	45	3.1	9	2.9	1	0.4	-	-
Other	18	2.7	6	2.0	10	5.0	5	2.9
Smoking								
Non/ex smoker	1214	82.0	246	75.9	146	74.1	142	84.7
Current smoker	266	18.0	78	24.1	81	25.9	26	15.3
	Mean	*95% CI*	*Mean*	*95% CI*	*Mean*	*95% CI*	*Mean*	*95% CI*
Age	45.4	44.1-46.6	45.9	43.3-48.4	51.1	48.2-54.1	47.4	43.1-51.7
BMI	27.6	27.2-27.9	27.7	26.7-28.6	29.8	28.4-31.1	29.2	28.0-30.4

SPADI pain percent score[†]	-	-	-	-	40.1	36.5-43.6[‡]	31.1	26.6-35.5[‡]
SPADI function percent score[†]	-	-	-	-	22.8	19.0-26.6[‡]	15.2	11.7-18.6[‡]
SPADI total percent score[†]	-	-	-	-	29.2	25.7-32.8[‡]	21.2	17.6-24.8[‡]

*Not stated category not reported
[†]Only includes respondents with a response score of 1 or more to the first pain question of SPADI. All scores presented as a percent score, range 0-100, 0=no pain or reduction in function, 100=worst pain imaginable or so difficult activity requires help
[‡]Significant difference between score $p<0.05$

Table 3: Multivariate analysis for incident shoulder pain compared to no shoulder pain, adjusted for age, sex, BMI

	Odds ratio	p-value
Sex		
Male	1.00	
Female	1.07 (0.74-1.54)	0.734
Age (St 2)	1.00 (0.99-1.01)	0.697
BMI (St 2)	1.01 (0.98-1.04)	0.498
Occupation (St 1)		
Sedentary	1.00	
Light	1.03 (0.65-1.64)	0.902
Medium	1.64 (1.05-2.56)	**0.031**
Heavy	1.92 (1.15-3.21)	**0.013**
Back pain (St 2)		
No	1.00	
Yes	2.46 (1.72-3.51)	**<0.001**
Foot pain (St 2)		
No	1.00	
Yes	1.68 (1.08-2.61)	**0.022**

Table 4: Multivariate analysis for recurrent shoulder pain compared to no shoulder pain, adjusted for age, sex, BMI

	Odds ratio	**p-value**
Sex		
Male	1.00	
Female	0.98 (0.62-1.55)	0.917
Age (St 2)	1.00 (0.98-1.02)	0.787
BMI (St 2)	1.01 (0.97-1.05)	0.643
Smoking (St2)		
Non/ex smoker	1.00	
Current smoker	2.10 (1.19-3.73)	**0.011**
CES-D (St 2)		
No depression	1.00	
Depressive symptoms	1.96 (1.07-3.58)	**0.029**
Work status (St 2)		
Full time employed	1.00	
Part time/ casual	0.72 (0.37-1.41)	0.341
Unemployed	0.94 (0.29-3.02)	0.920
Home duties	0.70 (0.32-1.52)	0.371
Retired	0.47 (0.23-0.99)	**0.046**
Student	0.03 (0.01-0.13)	**<0.001**

Other	0.71 (0.28-1.82)	0.481
Dominant sh flex (St 2)	0.98 (0.97-1.00)	**0.027**
Dominant sh abd (St 2)	0.98 (0.96-0.99)	**0.008**
Knee pain (St 2)		
No	1.00	
Yes	3.30 (2.09-5.20)	**<0.001**
Hip pain (St 2)		
No	1.00	
Yes	1.89 (1.10-3.27)	**0.022**
Back pain (St 2)		
No	1.00	
Yes	3.88 (2.36-6.37)	**<0.001**
Hand pain (St 2)		
No	1.00	
Yes	2.77 (1.79-4.29)	**<0.001**

Table 5: Multivariate analysis for resolved shoulder pain compared to no shoulder pain, adjusted for age, sex, BMI

	Odds ratio	**p-value**
Sex		
Male	1.00	
Female	3.21 (1.87-5.52)	<**0.001**
Age (St 2)	1.00 (0.98-1.02)	0.805
BMI (St 2)	1.01 (0.97-1.05)	0.610
Dominant hand grip strength	1.04 (1.01-1.07)	**0.004**
Dominant sh abd (St 2)	0.97 (0.96-0.98)	<**0.001**
Dominant external rotation (St 2)	0.98 (0.97-1.00)	**0.026**
Knee pain (St 2)		
No	1.00	
Yes	1.68 (1.05-2.69)	**0.031**
Back pain (St 2)		
No	1.00	
Yes	2.75 (1.79-4.24)	<**0.001**
Hand pain (St 2)		
No	1.00	

Yes	2.00 (1.19-3.36)	**0.009**