Physiotherapy and shoulder pain;

Coactive collaboration, supervised exercises in patients on a waiting list for surgery, and cost-of-illness in primary care.

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“The art of research is that of making a problem soluble by finding out ways of getting at it”

Peter Medawar: Advice to a Young Scientist, 1979.

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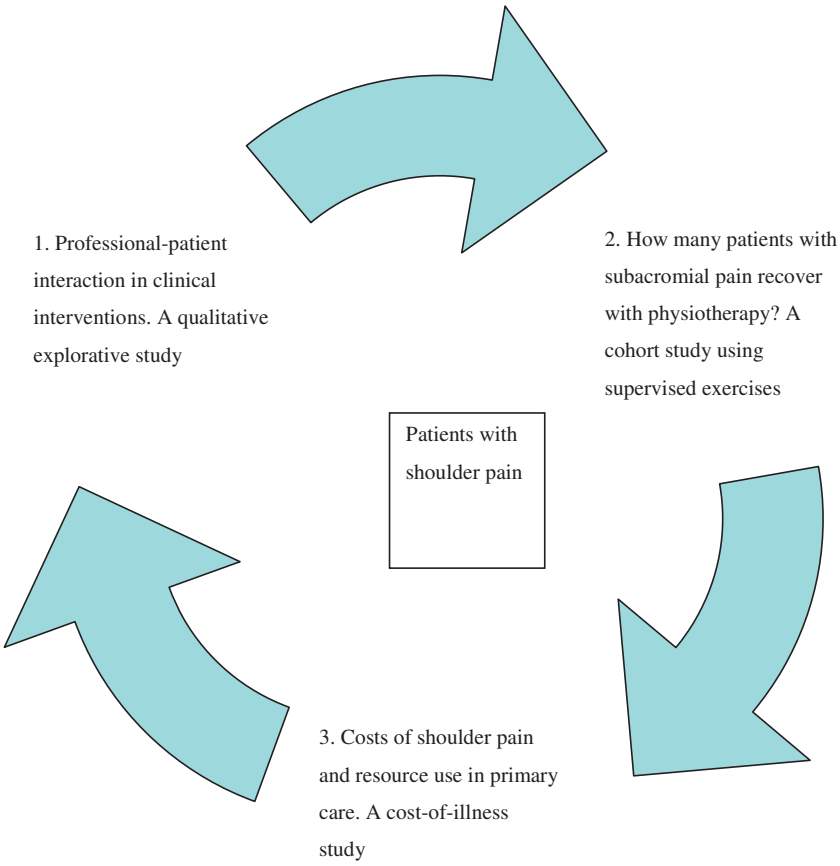
Thesis at a glance

The perspectives of the thesis:

The physiotherapy profession – the patient – the society: costs of illness



Included papers

I. Virta L, Eriksson R. Using video analysis to illuminate professional-patient interaction of clinical interventions. Practice Development in Health Care. 2008;7:143-55.

II. Virta L, Mortensen M, Eriksson R, Möller M. How many patients with subacromial impingement syndrome recover with physiotherapy? A follow-up study of a supervised e programme. Advances in Physiotherapy. 2009;11:166-73.

III. Virta L, Joranger P, Brox JI, Eriksson R. Costs of shoulder pain and resource use in primary health care: a cost-of-illness study in Sweden. BMC Musculoskeletal Disorders 2012, 13:17. doi:10.1186/1471-2474-1317.

SUMMARY

Background: Shoulder pain is a common cause of disability and lost work days. Rotator cuff disease, impingement syndrome or subacromial pain are similar labels used to describe the most common shoulder diagnosis. Similar results after surgery and exercises supervised by physiotherapist are reported in three randomised controlled trials in hospital settings. The content of the supervised exercise programme has not been explored with qualitative scientific methods. The feasibility of the supervised exercise programme in a specialist primary care setting has not been studied. Cost evaluations of different aspects of shoulder treatment are scarce.

Aims: The aim of the first study was to explore and define the communication and teaching techniques used by a physiotherapist in the initial part of the supervised exercise programme. The aim of study II was to evaluate the feasibility of this programme in surgical candidates in a local hospital, and the aim of study III was to evaluate the costs and resource allocation for shoulder treatment in primary health care in a small western Swedish county.

Methods: Study I is a qualitative explorative study, using observations with video recordings and field notes. A transcription model was developed and qualitative content analysis was applied to analyse the data. Study II is a prospective cohort study including patients with the impingement syndrome referred for surgical evaluation. The patients had physiotherapy using the method of supervised exercises and this treatment approach was also used in study I. Evaluation was un-blinded using a validated clinical outcome measure (the UCLA score). Study III is a cost-of-illness study with a societal perspective. Evaluation of costs and resource use was based on diagnostic codes and electronic patient records. A spreadsheet-based economic model was constructed. The human capital approach was used to calculate costs for sick leave and a supplementary sensitivity analysis estimated uncertainty due to changes in different parameters.

Results: The results of study I were presented in three content areas: context, interaction, and professional skills used in a process of motor learning. The term coactive collaboration was defined to describe the process. It was defined as the mutual effort made by physiotherapist and patient to reduce symptoms. This was accomplished in interaction, using verbal and non-verbal communication, including physical contact. In study II, 72 of 97 patients referred for surgery had in average 11 supervised exercise treatments during 8 weeks. Results were classified as excellent or good by 87% of the 72 patients, and they declined surgery. In study III the mean annual total cost for patients with shoulder pain in primary health care was €4139

per patient. Sick leave contributed to 84% of total costs, while physiotherapy treatments accounted for 60% of the healthcare costs or about 10% of total costs.
Conclusions: Study I emphasizes the interaction between physiotherapist and patient. This should be further explored in different settings and comparing different treatment approaches in future studies. With the limitation of the design applied in study II, most patients referred for surgery for the impingement syndrome declined surgery after an average of two months of supervised exercises. This may have consequences for sickness absence, health care costs, and for total costs of shoulder pain. In study III physiotherapy accounted for a major part of healthcare costs, but only a minor part of total costs for shoulder pain in primary care.

Key words: cost-of-illness, content analysis, digital video recordings, impingement syndrome, primary care, supervised exercises.

1. INTRODUCTION

The separate studies included in this thesis have been performed in collaboration with team members from separate disciplines. Cross-disciplinary research was defined by Epton, Payne, and Pearson as cited by Olkin and Sacks (1 p2): "a research task requiring a combination of disciplines is cross-disciplinary. The aim has been to stimulate the people from different fields to work together towards a common goal and go beyond the boundaries of everyone's own fields, to create new knowledge on a complex phenomenon."

2. BACKGROUND

Shoulder pain and disability can prevent the patients' normal activity and affect the ability to work. This poses a substantial socioeconomic burden. Most cases are effectively managed in primary health care, while some patients with persistent symptoms or depending on the diagnosis given may benefit from surgery.

The shoulder is complex in its structure and function. The aetiology of shoulder pain is diverse and many disorders present with similar symptoms and signs (2, 3). Most shoulder pain is exacerbated with arm elevation or overhead activities (4, 5). The differential diagnoses of shoulder pain is broad and may entail a number of causes (6). Mixed etiology and mixed findings on clinical and imaging evaluating are common, and the interpretation of imaging may be difficult because similar findings are observed in asymptomatic individuals. In most cases, detailed knowledge of the specific diagnosis will not alter initial management in primary care, according to one study (7). Subacromial pain, impingement syndrome, rotator cuff tendinopathy, rotator tendinosis, or rotator cuff disease, are labels used interchangeably to describe the most common complaints (2, 3, 6, 8). Poor agreement between the diagnostic labels used in electronic patient records (EPR) and ICD-9 codes has been reported (2). There is no consensus as to the diagnostic criteria for subacromial pain (9, 10), and lack of concordance in clinical assessment complicates treatment choices.

A rising incidence of shoulder surgery has been noted in the western world during the last decade (11). The problems are closely related to age (12), and therefore likely to increase with an ageing population.

Physiotherapy and pain medication usually constitute the first line of management for shoulder pain patients (7). However, there is a lack of formal evaluations of cost effectiveness of different alternatives. Preferably interverventions should be both effective and cheap, but the evidence from analyses of cost-effectiveness are often incomplete or inappropriate according to one study (13). A societal perspective is needed to cover all costs and consequences of different interventions. Economic analysis seeks to identify and to make explicit sets of criteria that may be useful in deciding among different uses of scarce resources (14).

Clinical knowledge and manual skills are essential tools in physiotherapy practice but rarely addressed in research. The therapeutic relationship, the importance of the interaction between patient and physiotherapist, is a concept often ignored (15). As Malterud (16 p397) argued: "The task of the physician is two-fold: to understand the patient and to understand the disease".

2.1 Shoulder pain

Shoulder pain is common in all western countries, and accounts for significant morbidity and disability in society. The 12-month prevalence in the general population has been estimated at 30% in the Netherlands (17), and 16 – 26% in the UK population (18). Luime et al. (19) found 1-year prevalence rates between 7- 47% and that about half of the patients had recurrences (47-65%). In a Swedish study (20), 8.5% of the women and 10.5% of the men reported chronic regional pain in the shoulder and/or upper arm, defined as persistent pain for more than 3 months or regularly recurrent shoulder pain over the last 12 months. Huisstede et al. (21) found substantial differences in reported prevalence rates on upper-extremity musculoskeletal disorders, mainly due to lack of uniform labelling or definition of these disorders. The prevalence increased with age with a peak at around 50 years and the prevalence remained stable at around 2% in the UK (22). Half of the new episodes of shoulder complaints presented in primary health care were completely recovered within six months (22, 23). At a one year follow-up 60% had recovered, while 13.6% were still consulting with a shoulder problem during the third year of follow-up (22). As reported by Andersson et al. (24), the neck-shoulder area was the most common site of pain in general practice in Sweden in the 1990's (30 % of the patients with chronic pain). They also found that prevalence of pain increased up to 50-59 years of age for both genders and then slowly

decreased. This suggests that shoulder pain will continue to pose a substantial economic burden on the healthcare system and on society in the future.

2.1.1 Aetiology

The glenohumeral joint is a mobile joint and muscle activation is important for midrange stability (25). Pain may alter timing and patterns of recruitment in the deepest layer muscles that constitute the rotator cuff, aimed at providing joint stiffness (26), and the superficial layer of muscles that are aimed at transforming load from the body to the arm (27). The tendons around the humeral head are formed as a continuous cuff, permitting the cuff muscles to provide an infinite variety of moments to rotate the humeral head and stabilize the glenohumeral joint (12, 25). This balance of stability and mobility can easily be disturbed and cause an impingement of soft tissue against the coraco-acromial arch (12). Intra-articular pathology such as degeneration or injuries to the labrum of the glenoid can present as secondary extra-articular impingement symptoms in younger people and overhead athletes (28, 29). Shoulder pain can be specific or non-specific. Specific pain is attributed to the rotator cuff, the glenohumeral and acromioclavicular joints (6, 18). In this thesis we have focused on shoulder pain not referred from the neck, but the exact aetiology may be difficult to discriminate and symptoms may overlap.

Subacromial impingement syndrome is used as a specific diagnosis although the causes can vary and clinical findings may differ. It may be considered as part of a degenerative process as well as a biomechanical phenomenon (30). Repetitive movements of the arm at above-horizontal levels, working with hand tools, and injury, appear to be factors of importance for subacromial impingement (31, 32).

The problems increase with age and are related to degeneration of tendon tissue (12, 33). Yamamoto et al. (34) found a 20.7% prevalence of rotator cuff tears in the general Japanese population, and the prevalence increased with age. The difficulties in interpreting this finding is illustrated by the finding that two-thirds of these persons had no symptoms involving the shoulder (35). Yamanaka and Matsumoto (36) studied patients with partial-thickness tears managed without surgery, and although the patients had improved shoulder scores more than one year later, 80% had enlargement of the tear size or progress to full-thickness tears. Yamaguchi et al. (37) reported similar findings.

2.1.2 Non-operative treatment of subacromial pain

Non-operative treatment of shoulder pain includes rest, subacromial corticosteroid injections, oral non-steroidal anti-inflammatory drugs, and physiotherapy (3, 6, 38). It has been reported that the results from most trials on physiotherapy treatment for patients with subacromial pain are inconclusive, partly due to imprecise description of exercise programmes (39) or a combination of exercise with other treatment modalities within the same treatment protocol (40). Evidence for the effectiveness of steroid injections for rotator cuff disease (41-43) and NSAIDs (44) is not convincing, but results support short-term efficacy (41, 42). Some studies support the effectiveness of acupuncture (5, 44, 45), and home exercises have also been effective (46, 47). Manual therapy in addition to exercises might (48, 49) or might not (50) be beneficial for the patients.

Recent evidence supports the use of therapeutic exercise in the short and long-term (5, 39, 46, 49, 51, 52). Some studies have attempted to find out which exercises to prescribe (46, 53). In a recent randomised controlled trial (RCT) (54) the number who had surgery was reduced by 80% with a supervised exercise regimen in combination with subacromial corticoid injections, in comparison to non-specific exercises.

Supervised exercises were equally effective as surgery for patients with subacromial pain in three randomised controlled trials (55-57). Two of these (55, 57) used the supervised exercise regimen including home exercises as described by Böhmer et al. (58, 59). Supervised exercises were more effective than placebo laser treatment (55), and radial extracorporeal shockwave (60) for patients with subacromial pain or the impingement syndrome.

2.1.3 Surgery

About 6,500 shoulders were operatively treated in Sweden in 2004, and since 1998 there has been an annual increase of about 10% (39). A recent study reported a four-fold increase in the number of acromioplasties for rotator cuff disorders of the shoulder in New York State from 1996 to 2006 (13). Multifactorial reasons were suggested for this increase, with patient-based, surgeon-based, and systems-based factors all playing a role. In Sweden, 2287 acromioplasties in the shoulder were registered in 2005 and 7959 in 2008 (Swedish Board of National Health).

Although evidence from case series supports surgical interventions for shoulder pain when used appropriately (43), little evidence was found to support or refute the effectiveness of surgery for rotator cuff disease (61). The increase in shoulder surgery cannot be explained by the practice of evidence-based medicine. In addition, most surgical patients have post-operative physiotherapy, sometimes for a long period, and some patients are re-operated. The costs and resource use for the post-operative rehabilitation and re-operation should be included when costs for surgery are discussed.

2.1.4 Management of shoulder pain in primary health care

Physiotherapy treatment is part of the fist-line management. Guidelines for general practitioners are available in several countries like the Netherlands (62), UK (7), New Zeeland (63), and Sweden (64). Non-operative care is recommended, including information on the prognosis of shoulder pain, and advice regarding physical activities. In addition, a step-by-step treatment progression, consisting of physiotherapy treatment, pain relief and corticosteroid injections, administered with or without local anaesthetic, is recommended. If non-operative treatment fails to reduce symptoms within 3-6 months, the patient is often referred to an orthopaedic surgeon for evaluation.

Distinctions between diagnostic groups are important if these groups have different prognosis or require different management decisions (65). However, the diagnostic value of the clinical tests commonly applied is under debate (30, 66), and according to two studies detailed knowledge of the specific diagnosis is not likely to change the course of initial management (6, 7). A pragmatic classification can be made to direct the initial intervention (6, 7). It is based on history (traumatic or insidious onset) and physical examination, including patterns of pain and dysfunction, and the different treatment regimes that follow. In study III patients were grouped as having non-specific shoulder pain; subacromial pain; stiffness; fractures; or dislocations.

Imaging techniques are generally not recommended for early mild symptoms, as initial management steps remain unchanged (7), and plain x-ray is recommended the first level of investigation (6, 7, 18, 38). Ultrasound is less expensive than MRI and can be considered to be equally effective in detecting full-thickness (67) or partial tears of the rotator cuff (68, 69), and pathology in the long head of the biceps muscle (67, 68). One study concluded that

neither ultrasound nor MRI were reliable for preoperative diagnosis of intratendinous or partial rotator cuff tears (70), and furthermore, structural changes do not correlate well with symptoms (30). According to two studies 25% of symptom-free shoulders in 65-year olds have a rotator cuff tear (34, 71).

2.2 Physiotherapy practice

Physiotherapy develops in clinical practice, and "efficient practice precedes the theory of it" (72 p54). Theoretical knowledge is the base for practice, but, as put by Higgs et al. (72 p54) "it cannot fully represent the entirety, the essence, the subtleties and the complexities of practice". The knowledge base that physiotherapists use in clinical situations is gained from theory and experience, and from the patient (73). Since theory and practice coexist and combine in practical settings, it is possible to observe skilled professionals in action and explore the nature of practice. Analysis of the observed actions can generate the underlying theory (72, 74).

Physiotherapy treatment sessions are complex. Communication between physiotherapist and patient is crucial. The patient's understanding and collaboration may improve the achievement of successful outcome (15). A treatment session may be defined by: the physiotherapist and the patient, the diagnostic label, the treatment technique, and the location (75). The complexity lies in how the actions are coordinated, how the two persons interact and how the outcome of the process can be related to these actions. Included in the treatment situation are biological, psychological, social and cultural factors (76), and the social sciences can provide suitable research methods for this area. An observational study with video recordings and an ethnographic approach is a natural choice to study physiotherapy practice, considering that physiotherapists "learn by doing", a traditional way of passing on both explicit and tacit knowledge from experienced colleagues (77).

2.3 Qualitative studies

Qualitative research methods take their approach from the social sciences, and they usually take place in natural settings. Data from interviews, tape or video recordings, are provided as research findings, often in thick descriptions (78), and the analysis of the findings include context (16, 79).This means, that the researcher should have some insight into the situation to

be able to understand the meaning of separate actions. The influence of the researcher's experiences, beliefs and personal history can be a resource rather than a source of error or bias (74), unless the researcher fails to mention them (80). Qualitative methods are able to explore the complexity of human behaviour and generate deeper understanding of therapeutic interactions (16, 74). The emphasis for qualitative research is on capturing in detail and depth something significant in the social world, focusing on the meanings of individuals' actions and explanations rather than their quantification (73). Treatment sessions can be observed and analysed with qualitative methods, in order to understand the practice of physiotherapy. A qualitative descriptive study influenced by ethnography (81) is suitable for studying physiotherapy practice. As Pope (77) put it, it is done in much the same way that anthropologists might study a cultural group. Thornquist (82) referred to the weakness in asking people what they do rather than observing what they actually do. Qualitative descriptions, as expressed by Sandelowski, (81 p335) are "less interpretive than 'interpretive descriptions'... and entails the presentation of the facts of the case in everyday language". Video recordings offer good possibilities to capture and register a complex treatment situation as it takes place in real life.

Only a few video studies were found in this field. Ek (75) thoroughly described the verbal communication that took place between the physiotherapist and a patient with a frozen shoulder during treatments. She followed principles of conversation analysis that have been developed to understand how and why conversations are or become organized in the way that they do. Thornquist (82, 83) video recorded first encounters between patients and physiotherapists to investigate diagnostics as a selective, interpretative, and interactive process in an ethnographic study. Magnusson (84) studied blind people's non-verbal communication using video films and interviews. Martin (85) published a video study about learning as a changing of patients' understanding and participation in treatments, also following principles of conversation analysis. In this tradition learning is described as a coaction that is bound to a particular situation and context (77, 84, 87). All researchers developed their own transcription models to combine verbal and visible information in their data analysis. None of them were applicable in our case, since we were not interested in analysing conversation in detail but more as messages, and how these were related to actions and arm movements. Language in this setting is a "vehicle of communication, not itself an interpretive structure that must be read", according to Sandelowski (81 p336).

2.4 Cost evaluations

Quantitative studies can also be descriptive. The differences lie within methodological aspects concerning: selection of participants (data), sampling and analysis of data, and the kind of knowledge that is gained (86). Costs of disease to society can be explored in a cost-of-illness study, where data and characteristics about a population or cohort of interest are described (14). Such studies are generally divided into two major categories: core costs resulting directly from the illness, and other related non-health costs (87). It answers questions like who has shoulder pain?, which resources are needed?, how long are people treated/on sick leave?, how much does this cost? Causal relationships and clinical outcome are usually not addressed. Disaggregating the costs in detail may provide a good overview of the size of a problem, and with some additional information from the patient records it is possible to show how the healthcare resources are used and the costs related to this. By arranging data into a meaningful pattern in an economic model, data can be analysed according to the given purpose. The model can be used for repeated evaluations and for different diagnostic groups.

2.5 Outcome assessment

Several methods for assessing outcome are available for use in patients. Outcome measures can be classified as generic or specific (88). Generic instruments measure health and life quality (89-93) and can be applicable to a wide range of health problems. Specific instruments are regions-, disease-, or condition specific, related and intended to measure the change interposed by the interventions (94). Still they can be more or less appropriate for specific shoulder conditions (94-99). Outcome may be evaluated by an assessor, blinded or not blinded, or by the patient (100, 101). Scores evaluated by an outcome assessor include pain, range of movement, overall severity, function, global improvement, tenderness, and muscle strength. Shoulder- or disease specific questionnaires filled in by the patients are subjective and usually include pain and function. They may in addition include other aspects like mental health and global improvement or satisfaction with treatment. Many of these instruments include different elements, for example pain and disability in an overall score, which makes it difficult to know what is really measured (102). An improvement in function is not always followed by reduction of pain, although these measures are usually at least moderately correlated. There is no consensus among researchers or clinicians about which instrument is

the most appropriate, and one study recommend using a combination of different outcomes (101).

2.5.1 Outcomes research

Studies on global outcomes of treatment focus on the usefulness of global interventions (86, 103, 104). *Efficacy* is usually defined as the effect of treatment delivered under carefully controlled conditions, mostly randomised controlled trials (14, 86). *Effectiveness* is defined as the usefulness of a particular treatment, given under typical clinical conditions (14, 86). The exclusivity of many trials is so great that the results may be difficult to extrapolate to practice (105). According to Kane (106) these findings will have to be "bent and shaped" to fit most clinical situations. The term *comparative effectiveness* or pragmatic trials are introduced to describe randomized trials in primary health care, but such trials can also be conducted in a hospital setting.

Performance measurements are complicated by the fact that different parties with different interests in health care perceive, define, and measure the quality of medical care differently. Donabedian (84) defined quality of care in the 1970's as a combination of structure, process and outcome (107). Structural evaluation deals with stable resources needed to provide care. Process evaluation consists of evaluating the degree to which services provided to patients meet professional standards of quality, for instance the use of practice guidelines. Donebedian's third element, outcome of care, is addressed directly in terms of death, morbidity, disability, or quality of life (107).

In physiotherapy the outcomes movement promoted the shift from traditional impairment outcomes to addressing broad disability outcomes (104). Despite this, physiotherapy research is still dominated by the impairment outcomes (86, 104). The perspective is more narrow and focus on outcomes related to body functions and structure, such as restriction in range of motion, muscle weakness, or velocity of gait. The broader perspective when effectiveness is discussed includes measures on how these factors affect disability, or social role, and represents the disability paradigm (106). The relationship between these perspectives is complex and affected by individual and environmental factors (104). Outcomes research can also be used to document geographic and cultural differences in the use of various medical procedures and treatment modalities for shoulder pain patients (108).

2.6 Aims of the thesis

The overall aim of this thesis was to generate knowledge in three areas of research related to shoulder pain: physiotherapy practice, treatment, and costs in primary healthcare. Such knowledge is important for improving quality and effectiveness of care and rehabilitation.

The aims of the separate studies were:

Study I: to explore and define the communication and techniques used by a physiotherapist in the initial part of the supervised exercise programme for patients with subacromial pain.

Study II: to evaluate the feasibility of the programme in surgical candidates with subacromial pain (impingement syndrome) in a local hospital in Norway.

Study III: to evaluate the costs and resource use for shoulder treatment in primary health care in a small western community in Sweden.

Questions asked in the studies were:

Study I: How did patients and the physiotherapist interact in a situation of motor learning? Which treatment strategies did the physiotherapist apply to help the patient to restore a normal pattern of movement in arm elevation?

Study II: Was a treatment regimen reported to be as effective as surgery in three previous clinical trials feasible in a local hospital in Norway? Presuming that all patients were surgical candidates, did the treatment change the expected treatment strategy?

Study III: What are the shoulder pain related treatment costs of primary care consulters in a county in Sweden? What are the costs of shoulder pain? What are the costs for sick leave? What are the total costs? Which factors contribute to the uncertainty of estimates?

3. METHODS

3.1 Design

Study I is an exploratory study on interaction in a situation of motor learning. The study was carried out with digital video recording and a video editing programme. An ethnographic approach and qualitative content analysis were used to study all ongoing events, in order to explore the physiotherapy skills, or tools, that were used in the process. A transcription model was developed to capture simultaneous events from the video films, constructed as film synopsis with time lines, using video editing software on a personal computer.

Study II was a prospective cohort study designed for patients with subacromial pain or the impingement syndrome referred for surgery at a local hospital. The aim was to assess the feasibility of physiotherapy at the hospital, and the study was performed within ordinary routines. The supervised exercises regimen was used for non-operative treatment.

Study III was a register study with a bottom-up approach, based on electronic patient records. The aim was to explore costs and resource use for shoulder pain patients in primary health care in two municipalities in western Sweden. An estimation of costs related to the patients who were referred to specialist care was added to mirror how the use of secondary health care affected the total costs. In order to construct an economic model we obtained information about administrative procedures and access to medical files.

3.2 Patients and physiotherapist

3.2.1 Patient selection and inclusion criteria

Purposive sampling is commonly done to obtain qualitative material (80). Patients with the diagnosis subacromial pain or the impingement syndrome were already referred to the clinic, and according to the local orthopaedic surgeon they were candidates for surgery. The patients were referred to the orthopaedic clinic from various healthcare centres in the area, and they were investigated by one experienced orthopaedic surgeon following ordinary routines. The criteria for inclusion were the same in studies I and II, and the conduction overlapped in time. The inclusion criteria were: Dysfunction or a disturbed pattern of movement in arm elevation, positive impingement sign and a positive impingement test according to Neer

(109). The latter means that the impingement sign is no longer positive after an injection of local anaesthetics (5ml Lidocaine) into the subacromial space. The surgeon did not use a quantitative pain measurement like a visual analogue scale to assess the efficacy of the injection. Patients with reduced glenohumeral motion and major tears of the rotator cuff were excluded. Patients, who had not previously taken a supervised exercises regimen, were referred for supervised exercises. Most patients had previously received various physiotherapy treatments, like massage, mobilisation, hot packs, ultrasound, laser or exercises. Most patients had also taken pain medication and anti-inflammatory medication including non-steroidal anti-inflammatory tablets and cortisone injections. The number of physiotherapy sessions or medication was not systematically registered. MRI had been taken in 92 patients and x-ray examination in 69 patients. One hundred consecutive patients that fulfilled the criteria for the study were informed about the study. A flow chart including all the patients assessed for inclusion and the reasons for not being included was not obtained. Six consecutive patients were assigned for study I.

Purposive sampling was used in study III. It was performed in 2009, in two municipalities comprising 24 000 inhabitants, in a prosperous region on the Swedish west coast. The labour market in this region is based on trade and tourism, as well as many small and medium-sized enterprises, and the level of unemployment is low. Patients being permanent residents in either of the two municipalities and between 20 and 64 years of age were included if they had any shoulder specific diagnostic code or a potential code as explained below.

3.2.2 Physiotherapist

For study I a question was posed among physiotherapists working with shoulder patients, and an experienced colleague volunteered to take part in the study. She had worked as a physiotherapist for 24 years and had used the supervised exercises regimen for 12 years; seven of these at Oslo University Hospital (Ullevaal). She also treated all the patients in study II.

3.2.3 Diagnostic codes used in study III

The diagnostic coding system International Classification of Disease, version 10 (ICD-10), was used. In study III, initially a pilot study was performed at all six participating units to find

out which diagnostic codes were used when patients consulted for shoulder pain. Fractures and dislocations of the shoulder were included, following recommendations from an earlier study (110), to cover the broad range of shoulder patients in primary health care. All visits with known and potential codes for shoulder pain were retrieved from the electronic patient records (EPR) system. Each individual with a potential code was scrutinized by comparing data within the EPR to verify the cause of a visit. In the last step, 29 codes were classified in four categories, presented in table 1: Subacromial pain (including non-specific shoulder pain), stiffness (adhesive capsulitis, arthritis), dislocations, and fractures.

Table 1. Diagnostic codes. The International Classification of Diseases, version 10 (ICD-10) was used for shoulder pain and 29 codes merged into four categories.

Subgroups	Diagnostic codes
Subacromial pain	M751-9, M759P, M709, M779, M791, M799, M255, M255B, M629, M795, M796B
Stiffness	M750, M190B, M192B
Fractures	S420, S4200, S429
Dislocations	S430, S431, S435, S460

M751-M759. Shoulder lesions
M70.-M79.(B) Other soft tissue disorders (shoulder)
M255 (B) Pain in joint (shoulder)
M750 Adhesive capsulitis
M629 Disorder of muscle
M19.(B) Arthrosis(shoulder)

3.3 Data collection and procedures

3.3.1 Study I

The six consecutive patients were video recorded during two separate treatments. Eleven videotapes were produced since one case was closed before the second recording occasion. Background information was collected in field notes, questionnaires to the physiotherapist and, if needed, direct questions to the physiotherapist for additional information and deeper understanding during analysis. Geertz (78) used the expression “thick descriptions” to

describe the data that can be used in such a qualitative study. We created the expression "thicker descriptions" (111) for the use of video recording, since it captures all sorts of information during simultaneous events including human movements, sounds, and body positions. A selection of variables had to be made, in order to handle the amount of data provided. A time-line was used in order to register sequence blocks. Phenomena were to be attended to as they appeared on the film, and were described, not explained. We registered all communication during the session: dialogue, silence, vocal expressions, and hand movements on a time-line, illustrated in figure 1. A three-dimensional protocol would have facilitated the understanding of simultaneous events, but the computer soft-ware available (Auto-Cad) was not suitable for registration of time. Hence, simultaneous reporting was made by hand on long sheets of paper, paper copies, and transparency film.

Figure 1

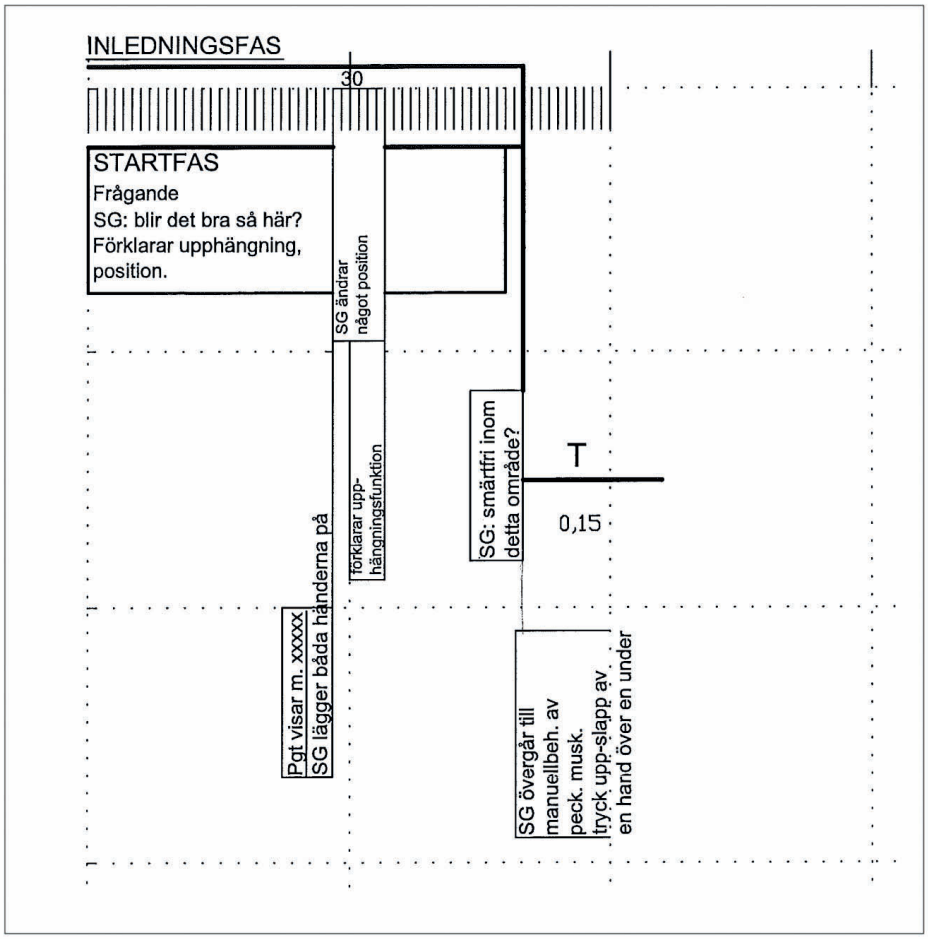


Figure 1

The time-line, drawn in computer program Auto-Cad at an early stage.
Inledningsfas=Starting phase, SG=physiotherapist, Pgt=patient, T=silence.

The conversation was examined with respect to structure, time, and role distribution. Analysis of data followed the principles of qualitative content analysis (112, 113). Each event with a coherent manifest and latent content was considered to be a unit of analysis and given a moniker, a code, on the transcript. This process is called tagging in content analysis (114). Simple words reflecting an image, a metaphore, were tagged as “word/image”. Several words used together as a verbal instruction were tagged as “word/instruction”, and a short request, encouragement or confirmation from the physiotherapist was tagged as “up!” (*uppmaning,*

uppmuntran in Swedish). These vocal expressions together with paralinguistic expressions and sounds were not expected to be answered and monitored the intentions of the physiotherapist. When the patient and the physiotherapist communicated verbally, this was tagged as "*dialogue*". The codes were grouped together into sub-categories that finally merged into four categories: *dialogue*, *other vocal expressions*, *silence,* and *situations of hands-on/hands-off*. These categories were deemed as most important to reflect interaction in this motor skills learning situation. The whole process was analysed from three perspectives, or content areas: context, interaction, and professional skill.

3.3.2 Study II

The same experienced physiotherapist treated all the patients. There was no limit for the amount of treatments. Patients paid for their treatments as a normal procedure, while physiotherapy for the first 6 months after surgery is public funded and free of charge in Norway. There is a government-imposed patient's cost ceiling which means that access to physiotherapy is free after 20 treatments. We had no information about if any patient declined to participate in the study for economical reasons.

The same non-blinded physiotherapist made all the registrations before and after treatment. The study was performed within daily routines and without additional resources. In lack of progress the patient was sent back to the orthopaedic surgeon for re-evaluation.

3.3.2.1 Outcome measurements

The University of California at Los Angeles Shoulder Rating scale, the UCLA score, was used as primary outcome for the assessment of the intervention. It was originally designed for assessing shoulder arthroplasty outcomes (115). It has proved to be as useful as other scoring systems in assessing outcomes from rotator cuff surgery (116, 117) as well as for patient self-administration (118). It is easy to administer in clinical practice, and inter-tester reliability is reported to be acceptable (118). The UCLA scoring system assigns a score to patients based on 5 separate domains: pain, function, active forward flexion, strength of forward flexion, and overall satisfaction. The 5 domains are assigned various weights; pain and function are given 28.6% each, while ROM, strength, and overall satisfaction are given 14.3% each. Forward flexion is measured in active mode while standing (119). Manual resistance is used to

measure strength in forward flexion. Pain is filled in by the assessor and graded from 0-10 with alternatives given at 1, 2, 4, 6, 8, or 10 points (no pain). Six points means pain only in combination with hard work or specific activities and seldom use of medication. Function is scored from 1-10 (normal), alternatives given at the same points as for pain but related to daily activities. Six points means that most housework is restricted and in addition washing hair, doing the bra, shopping, and driving. Active forward flexion is graded from 0-5 and based on full range of movement in the following intervals: 0-30˚ 31-45˚; 46-90˚; 91-120˚; 121-150˚; >151º. Muscle strength of forward flexion is graded from 0-5; five points means normal strength against manual resistance above 90 degrees, while three points means fair strength, which means full active range of movement against gravity.

The maximum score is 35 points. The overall satisfaction item is not valid before intervention since it is graded 0 (not satisfied) or 5 (better and satisfied). Outline categories were: excellent (34-35 points), good (28-33 points), fair (21-27 points), and poor (0-20 points).

3.3.2.2 Other measurements and registrations

Gender, age, dominant arm and perceived work load were registered at baseline in all patients, as well as duration of symptoms and earlier treatment. A non-validated questionnaire developed by three shoulder surgeons was used to assess work load. Work load was classified as: not working; light (office); moderate; or heavy load (on or above shoulder level). A question was also posed after the treatment period was ended, whether the patients would recommend the supervised exercises as treatment to others (yes, no, do not know).

Outside the study the patients who had surgery were monitored in a clinical follow-up after five years by the responsible surgeon. Results of structural findings at surgery and how the patient recovered are presented in the appendix.

3.3.2.3 The intervention

The supervised exercise regimen was introduced by physiotherapist Audhild Böhmer more than 30 years ago for use particularly in patients with subacromial pain at Oslo University Hospital, Ullevaal (55, 58, 59). The treatment was provided in two sixty minutes sessions weekly until physiotherapist and patient were satisfied or either of them decided to stop due to

lack of progress. Before each session the physiotherapist evaluated the movement patterns by observation of alignments and structures, and how the arm elevation was performed. Joint mobilisation was performed if joint movement was restricted, and home exercises were included when movement patterns were correct.

The purpose of this programme is to reduce pain, restore normal patterns of movement, restore functional capacity, and prevent relapse (59). It emphasises according to Bøhmer:
1. Positioning of the scapula and the humeral head;
2. Reduction of mechanical subacromial stress with the arm in a sling to avoid the influence of gravity;
3. Stimulation of collagen tissue by appropriate tensile forces;
4. Supervised training of scapular control and timing of the rotator cuff muscles as steerers of the humeral head, to avoid humeral motion in unwanted directions;
5. A few, basic exercises which gradually increased dynamic control and loading;
6. When normal movement patterns are achieved; endurance training, progressive overloading, and eccentric muscle strength training with increased speed of contraction are performed.

The essential in the initial phase of the programme according to Bøhmer is to unload the stress on the rotator cuff and subacromial structures by the use of a sling (sling-exercise therapy), attached to the ceiling, to allow pain free movements, guided by the physiotherapist's hands. A thin elastic cord was used as a "guiding line" for relaxed repetitive movements in correct patterns, in the early phase, as described in paper I. The progression of the programme was made from isolated movements around the glenohumeral joint, integrated with scapular stability in functional movements, and then combined with core stability in more and more demanding tasks, varying from laying down on a bench, to sitting and finally to standing position. To increase the eccentric force in m. supraspinatus and m. infraspinatus when lowering the arm was essential in all positions. Progression was made as soon as the patient knew how to perform the movement.

Home exercises such as alignment correction and controlled motor patterns during daily activities were an essential part of the programme. Specific exercises were directed towards tendon healing and stretching if needed, while strength and endurance would increase with normal daily activities. The number of home exercises was not registered in this study.

3.3.3 Study III

For study III we constructed a spreadsheet- including data from compiled files in a Swedish system for medical documentation. These files contained patients' personal identity number, age, sex, dates of medical examinations and diagnostic codes for every visit, the number of admissions and referrals to specialist care, and x-rays, the number of drug prescriptions and sick-leave periods prescribed by a general practitioner. Our first step was to retrieve all visits to a general practitioner or physiotherapist caused by shoulder pain during the given time period, from March 1 to Sept 30 2009. All transferrals were manually controlled so that nothing was lost on the way. All data were anonymised before analysis.

The most important cost components that were registered in electronic patient records were evaluated. Healthcare costs and total costs, including cost for sick leave prescribed by general practitioner, were explored. Health care costs were retrieved from a pricelist for the Western Health Care region (120). We used a bottom-up approach and performed the costing procedure in three steps (121): 1. Identification of relevant cost-items; 2. Quantification of the use of the identified cost items; 3. Valuing the identified items.

Further details on the procedure are described in paper III. The cost for sick leave was for the baseline value calculated according to the human capital approach (14, 122). This method places monetary weights on healthy time using market wage rates. It is an estimation of changes in productivity, based on the opportunity cost of the production that people would have contributed to, had they been at work. We presume that salary reflects production costs. In Sweden, people have the right to sick leave shorter than eight days without seeing a doctor, unless the employer has decided otherwise. In this study, we had information only about sick leave periods graded from 25 to 100% of full working time prescribed by general practitioners. The cost per day was calculated from a mean income in the region in 2008, provided by the Swedish Bureau of Statistics. The costs for productivity loss due to sick leave were calculated after this model presented by the Swedish Ministry of Industry in 2001 (123): Costs for productivity loss = Mean income + social fares 40% + indirect taxes 28%.

An alternative approach to the human capital method is the friction cost method (14, 122), which is recommended in Dutch studies (110, 124). In that case we assume that when a

person has a period of sick leave, there is a pool of unemployed people that can replace the sick person. Hence, there will only be a productivity loss in a “friction” period until the new employee is recruited and trained to do the job. It is frequently argued that evaluations using the human capital approach overestimate the true costs to society (14).

The economic model can be used for follow-up of any group of patients on a local level, and the sum can be multiplied by 2 for an annual cost on a group level, considering the seasonal variations that might be present for specific groups.

3.4 Statistical analysis

3.4.1 Study II

Descriptive statistics was used to describe the number of patients with excellent, good, fair, or poor results. The number of treatments, duration of symptoms and mean UCLA score at baseline and end of treatment was described in four, equally large, age cohorts. UCLA score classification was described according to duration of symptoms before treatment. A paired t-test was used to assess the change from baseline to after the treatment period.

3.4.2 Study III

Costs were calculated for a six-month period. The arithmetic mean, standard deviations, and median value were used to provide information about the total cost of treatment for all patients, and to illustrate the skewness in the distribution of costs and resource use. The total costs for six months were multiplied by two in order to estimate the annual total cost for patients with shoulder pain in primary health care.

One-way and two-way sensitivity analyses were performed to explore the uncertainty, to demonstrate the impact of one parameter varying in the model, and to examine the relationship of two or more different parameters changing simultaneously.

We used a linear multivariable regression analysis to find out how gender, age and municipality as independent variables, correlated with total cost, health service cost and the

number of days on sick leave. Regressions were made both with and without taking the logarithm of the dependent variables.

3.5 Ethics

The patients gave their informed consent for participation, and so did the physiotherapist providing the treatment. For the video study we asked for advice from the Regional Ethical Review Board of Health Region South East of Norway. The study was considered as professional development, and no application was needed. Study II was performed for quality assurance, to investigate how the hospital's resources were most effectively used. All data were anonymised. The hospital board approved of these studies. Study III was a study based on patient's medical records. The Regional Ethical Review Board of Gothenburg approved the study. We also made a registration according to the Personal Data Act. The purpose of this Act is to protect people against the violation of their personal integrity by processing of personal data in Sweden.

3.5.1 Video films and electronic patient records

Technical evaluation has made possible the collection, storage, and dissemination of data on a massive scale. Issues regarding privacy and confidentiality must be weighed against public interest such as quality, cost control, and research perspective. Informed consent and security must be discussed not only in research projects but also when data is extracted from medical records for decision making purposes (125). De-identification of data, in a way that it cannot be re-identified, and restrictions on the migration of data, are ways to deal with this (126), since requiring patient consent as a condition of researcher access is impractical, expensive, and might even be impossible. If data are truly anonymous, and publication of data will appear only in aggregate form, consent might not be necessary. For study I we asked Regional Ethical Review Board of Health Region South East of Norway for advice, and in study III the Regional Ethical Review Board of Gothenburg approved the study.

In study III, patients were informed about the study on notice boards at all participating units. All inhabitants in the area had been informed from the county council that information from their electronic patient records could be accessed and processed without informed consent for planning and quality assurance. Only de-identified data were extracted from the primary

health care computer system into new files, and all data were de-identified before analysis. Additional information had been retrieved from the electronic patient records to confirm that visits were caused by shoulder pain. Only the responsible researcher had access to the files, and no information of this sort was stored outside the local data system. This was the only way to ensure the validity of the data.

All scientific activity involves some method of observation and some method of recording of what has been observed. Special attention must be paid towards video recordings, since patients can be identified by appearance or by their voices. This was also the case for the physiotherapist giving the treatments. The patients in study I had given their informed consent to participate in a research study. For the final step, the communication of research, we made new films, with new participants, who gave their informed consent to how this new material was to be used.

4. MAIN RESULTS

Study I

Two women and four men were observed; median age was 51 years, range 40-56 years. The results were presented in three content areas: the context – how the treatment situation was organized; the interaction - how patient and physiotherapist interacted in this situation of motor learning; and professional skills – what the physiotherapist did to help the patient to restore a normal pattern of movement. The concept coactive collaboration was introduced and defined as the mutual effort made by physiotherapist and patient to reduce the patient's symptoms. It is accomplished in interaction and based on verbal and non-verbal communication, including physical contact.

Study II

Ninety-seven patients (60 women and 37 men) received the intervention; median age was 51 (range 24-80) years. Three were excluded due to frozen shoulder which appeared when assessed by the physiotherapist. Seventy-two (74%) patients referred for surgery fulfilled the supervised exercises programme. They had in average 11 treatments during 8 weeks. Results were classified as excellent or good by 87% and they declined surgery. No difference was found in the results related to sex, age, number of treatments, duration of symptoms, or work load. These results suggest that the supervised exercises programme is feasible for patients with subacromial pain referred for surgery in a local hospital and that the number operated on may be reduced.

Study III

A total of 204 (103 women) patients, mean age 48 (SD11) years, were registered for visits to general practitioner or physiotherapist during six months. Seven (4%) of these had been operated on, whereas additional four (2% of the total sample) of the 29 (14%) patients referred to orthopaedic surgeon during the measuring period were recommended surgery within a year. The *mean healthcare cost* per patient was €326 (SD389) during six months. *Median healthcare cost* was €200 (Inter Quartile Range 113-397) for the whole group, whereas the *median total cost* was €249 (IQR 119-661). Mean *annual total cost* for patients with shoulder pain in primary health care was €4139 per patient. Sick leave prescribed by general practitioner contributed to 84% of total costs. A fifth of the patients generated 91% of the total costs, and 44% of the healthcare costs. Physiotherapy treatments accounted for 60%

of the healthcare costs, or about 10% of total costs. The total cost was most sensitive to the choice of method for estimating the sick leave cost.

5. DISCUSSION

5.1 Methodological considerations

5.1.1 Patient sample and representativeness

The patients in study I and II were referred to the local orthopaedic clinic after various treatments including medication and physiotherapy had failed to reduce their symptoms. All were evaluated by an experienced orthopaedic surgeon. He applied commonly used clinical and imaging procedures and found that surgery was indicated. This suggests that these patients were representative of those who are commonly operated for this condition. In the setting of the present study including the availability of an experienced physiotherapist at the orthopaedic clinic, the supervised exercises regimen was recommended by the orthopaedic specialist before a final decision on surgery was made. We did not register the number of patients who declined to participate. Three patients developed a frozen shoulder and were excluded after inclusion, and this phenomenon has been reported in other studies (54, 55, 60).

A clinical setting might result in a different population compared to a randomized controlled study. The external validity may be reduced when study populations are so narrowly defined that many patients with similar symptoms are excluded. The patients then may not represent patients with a similar diagnosis (105). Many patients are excluded from studies although most authors do not tell how many patients they have excluded. Brox et al. (55) included 125 patients out of 444 that were referred to his study by general practitioners, with rotator cuff disease as the diagnostic criteria. They were aged 18-66; had had pain in the shoulder for at least three months that had been resistant to outpatient physiotherapy and non-steroid and steroid anti-inflammatory drugs. They had dysfunction or pain on abduction, had a normal passive glenohumeral range of movement, positive isometric-eccentric tests and pain relief after subacromial anaesthesia. Most patients in this study were excluded because their diagnosis was changed after evaluation at the specialist clinic, but also patients that were not willing to participate in the randomised trial. The validity of the clinical diagnostic criteria applied is continously discussed (30, 127, 128).

A limitation of the present study is that a flow chart was not used and that the number of patients excluded before entering the study was not registered. The available information is not sufficient for comparison of the patients in the two studies, but quite similar criteria for

inclusion have been applied. While the number of patients who receive surgery for this condition has increased markedly according to previously referred studies, the criteria for surgery are likely to be less restrictive.

5.1.2 Validity in qualitative and register studies

In qualitative studies researchers seek descriptive validity, trustworthiness, or "an accurate accounting of events that most people (including researchers and participants) observing the same event would agree is accurate, and interpretive validity, or an accurate accounting of the meanings participants attributed to those events that those participants would agree is accurate" (81 p334). The findings are descriptions applicable within a given context, and trustworthiness can be assured in several ways. In the present study the credibility of findings were assured by "debriefing" (73 p327), short complementary questions to the physiotherapist after each session to clarify what had been observed. The physiotherapist was invited to watch the films to clarify the intention of the actions in her own words, which is described as member checking, or respondent validation (74). In addition, the contemporaneous reflexions of the author were tape recorded and transcribed immediately after each session to make later analysis easier. Other experienced colleagues were invited to see the films when paper II was written (paper II p4). The content of the programme was discussed which strengthened the initial analysis. This suggests that judgements and findings of the content were consistent over time, which is described as dependability in one article (112).

Confirmability of the data is increased when video recordings and registers are used (74). Analyses can easily be repeated and interpretations of the content can be discussed to reach concsensus (agreement) or valid disagreement.

The reproducibility of study III depends on the choice of diagnostic codes, cost items, and the values given to those items. Twenty-nine diagnostic codes were identified during a six-month measuring period in two municipalities on the Swedish west coast. Since there were only a few private alternatives to primary health care, we most likely captured most patients who consulted for shoulder impairment. Some patients may have been missed if they had been registered with a code related to other medical problems. In such cases we presumed that the shoulder pain was a minor problem to the patient, and would have little influence on the results.

Sampling was conducted for six months during the summer period and extrapolated to represent the whole year. We cannot exclude seasonal variation in shoulder pain so in the absence of results for the winter period results are strictly valid only for the summer period.

Despite a small sample the cost-of-illness study is reliable, considering the manual control of variables included. Generalization of findings to other regions cannot be done without comparing the variables included and the organisation of primary health care in other regions.

5.1.3 Design: strengths and limitations

Study I

The advantage with video recordings is that all therapeutic actions can be observed, registered, and analysed at repeated occasions and from different points of view. To observe with the naked eye and believe that one has seen and remembered everything has been shown to be deceitful (129, 130). Data in the present study was saved and available for other researchers or physiotherapists to view, analyse, and comment. Quantitative studies contain written instructions about *what* exercises that are recommended for patients with subacromial pain. Video recordings add the aspect of *how* they are communicated and performed. Such studies can be useful for understanding the communication between the patient and the physiotherapist and can be applied on a descriptive level (16). Study I does not provide evidence for a causal role of communication skills or manual skills in therapeutic success. By example we have little information about whether the motor task - arm elevation - had improved or not.

A disadvantage using video observations is the huge amount of information that has to be handled, transcribed and analysed with accuracy. It is time-consuming and costly, but may provide information that quantitative studies cannot. On beforehand no instrument was available to register the type and frequency of the therapist's actions aimed at improving motor learning. The instrument developed for the present study was time-consuming to use for analysis and thus not recommendable for future studies. A new instrument can be tested for test-retest reliability and used for follow-up (82, 131). Similar studies including other physiotherapists will most likely show other verbal actions aimed at enhancing motor learning, reflecting differences between therapists or patients.

The presence of an observer and a video camera might introduce an element of bias in the treatment situation, particularly in the beginning of a session. It was our experience that shortly thereafter the patient and the physiotherapist were engaged in the treatment process and not disturbed by the observer. Other researchers have concluded that most people are unable to act differently from the way they normally do, even if they are observed (83).

The treatment session could have been analysed and presented according to Jensen et al. (132). They explored the conceptual framework for physiotherapy work in three levels: level I consists of the physiotherapist's professional characteristics, the patient's characteristics, and organisational factors such as the setting (the content in the present study); level II includes available tools used by the physiotherapist including communication, manual techniques and various modalities (the professional skills), while level III is the dynamic intervention (interaction), and the filter, that all of the identified level I and level II factors are filtered through. At the end of this process is the patient outcome. These complex interactions constitute treatment sessions, and paper I can be read and understood with this filter in mind. The framework described by Jensen et al. (133) was later merged into two dimensions: knowledge & skill, and interpersonal skills & caring.

The analysis of the treatment session also monitored motor teaching principles, following Niemeijer et al (134). Three categories based on motor learning theory and video observations were identified for improving motor learning: giving instructions, providing or asking feedback, and sharing knowledge. The frequency of the use of the identified principles was correlated with changes in motor performance. These principles were also identified in the present study and will be discussed below in relation to findings in other studies.

Video observations can be used for practice development. The analysis may raise physiotherapists' awareness of the ongoing process between the physiotherapist and the patient. The recordings make it possible to review and reflect on practice in considerable detail, which may offer a good start for practice development, education, and research. During the analysis of the present study, repeated viewings of video films rendered more and more information. Systematic documentation and analysis became reflection-on-action, as described by Schön (135). Also, the work contributed to the development of a practical learning programme for physiotherapists.

Study II

The main weaknesses in study II were lack of control group, observer bias, and loss to follow-up. The physiotherapist who performed the intervention made all measurements. A disadvantage with single-group studies is that the design does not account for the possibility that patients can make similar gains without a formal rehabilitation programme. The lack of control group and a randomised design means that the study was not designed to examine a possible causal relationship between the intervention and outcome.

Observation bias is caused by the one-to-one relationship between patient and physiotherapist (136). How people exchange signals unintentionally, without speaking, is a known phenomenon in behavioural research. This was seen already in the 1950s in studies on rats, as discussed by Laake et al (137 pp118-119), when experimenters were deliberately biased by having been provided with false information about some rats being “bright” and others being “dull”, although they were from the same colony. The experimenters that treated the “bright” rats observed better performance of the rats and rated themselves as more enthusiastic and interested than those treating the “dull” rats.

In the present study a self-reported outcome should have been used, alternatively a blinded physiotherapist should have been engaged to perform assessment. Although the main objective of the present study was to study the feasibility of the supervised exercises regimen at a local hospital, standards to reduce bias should have been implemented in order to improve the quality of the study.

Seventy-four percent of the patients completed the treatment. Baseline data were not compared for those attending and completing follow-up and those who did not. Results in those who did not attend were not available and although these patients may have poorer results, the main conclusion is that results are unknown. Drop-outs from treatment and follow-up suggest thtat selection bias may influence results and this reduces the validity of the study.

The supervised exercise programme was the same as had been used earlier (55, 59) by a group in Oslo, and repeated in two more recent studies (57, 60). The physiotherapists who

supervised the exercises in the aforementioned trials had all been trained at Oslo University Hospital (Ullevaal) or visited the clinic to learn the method. This suggests that the patients included in papers I and II most likely had similar treatment to those in the cited studies. The results from the published trials are less biased than the non-blinded observation performed by the physiotherapist in the present study.

The fact that the patients had to pay for physiotherapy treatment, but not for surgery, might have influenced the results. However, only two patients left the study for economical reasons, whereas four patients left the study without explanation. There were no figures available regarding how many patients would normally be expected to withdraw from a waiting list for surgery.

Study III

The strength of this study is that we were able to capture almost all patients consulting a general practitioner or physiotherapist with all types of shoulder pain during a six-month period. There were few alternatives to medical care and data were manually controlled. A limitation is that we do not know if patients were relieved from their symptoms when the treatment period was ended, or if they disappeared out of the system for other reasons. The costs were limited to the primary diagnoses for the visit, and ignored costs associated with comorbidity. This lack of information is often the case in cost-of-illness studies and a simplification of real life, as was pointed out by Koopmanschap (138).

We could only observe and register sick-leave prescribed by general practitioners, not by orthopaedic surgeons post-operatively. The costs for sick leave were probably underestimated with this study design. On the other hand, we do not know if patients were actually absent from work all that time. We had no information on short time sick leave.

To fully estimate the total cost for patients with shoulder pain we could have required additional information from the patients themselves and from the hospital. Self-reported data in logbooks or cost-diaries (110, 139, 140) have been used to register all procedures including post-operative care, medication, sick-leave prescribed by specialist, and short-term sick-leave. However, self-reported data on days of sick leave (141), and number of physiotherapy contacts (144) have been reported to be less valid than register-based data, whereas specialist

care contacts were generally in agreement with data from an insurance company (144). Only one county in Sweden, Östergötland County, has a system were all data on hospital care and primary health care have been entered in a diagnosis administrative database since 1999 (142). With the help of a statistician we retrieved the annual healthcare cost for shoulder pain patients in Östergötland, but no information was available about how the cost items were valued. We could therefore not compare our figures to theirs, but this attempt showed the importance of standardised costs and methodology (124), and that generalization to other settings might be difficult.

We had no information on real consumption of or total costs for medication; this would have required another study design. Most medication for shoulder pain can also be used for other types of musculoskeletal pain. In addition retrievals from registers are not reliable because the most common medication is bought without a prescription. However, the sensitivity analysis showed that costs for medication were relatively low and had a minor influence on the total costs in the present study.

5.1.4 Outcome measures

Kirkely et al. (102) reviewed the shoulder instruments in use in 2003. The UCLA-score contains both subjective and objective measures combined for a total score. The terms subjective and objective refers to patient evaluated or assessor evaluated outcome. In a patient with shoulder pain, however, objective measures of muscle strength are influenced by pain (143, 144). Merging different variables into a single score or index is discussed and also giving different variables different weights has been questioned, since the reasons for this are not known (96, 102). Large measurement error has been reported for the Constant score (145) and the Rowe score (96).

There is little evidence to conclude that combined scores are more reliable and valid than a questionnaire. An acceptable correlation was reported between the Constant Score, UCLA, and American Shoulder and Elbow - Shoulder Evaluation Form in a Dutch study (146). Self-report questionnaires are easier to administer and not hampered by inter-observer disagreement and such instruments are often preferred today. Norwegian versions of three shoulder questionnaires (147) and two Swedish versions (94, 99) have recently been tested for reliability, validity and responsiveness in patients with shoulder pain. The quality of study II

could have been improved by choosing a self-report questionnaire instead of the UCLA score, thereby reducing observer bias.

Outcome measurements should distinguish pain from functional disability and ability to work. Additional outcome measures that can be used are by example: time to functional recovery and return to work (51), and the impact of shoulder function on current profession and sports or leisure activities (90).

5.1.5 Statistical methods

Study II

Simple descriptive statistics was used and showed that results were similar in different age groups, in men and women, in patients with short and long duration of symptoms, in patients reporting different work load, with dominant or non-dominant shoulder being involved, or with a different number of exercise sessions taken. Also the quarter of patients with the lowest UCLA score at start performed well when the scores at start and at end were compared. People with the poorest performance improve the most, which may be attributed to regression towards the mean. More advanced statistical methods like multiple regression could have been applied to assess the relative contribution of possible confounders, but only simple tables were used. The lack of association of the possible confounders and outcome as assessed in these tables, means that these factors most likely have not influenced outcome in the present study.

Study III

With the methodology applied it is possible to calculate the annual cost for society for the specified group of patients by multiplying the half year-results by two, if seasonal variations are considered small. For this particular group of patients we know that fractures and dislocations are more frequent during the winter, although the major costs for this will appear on second care level. The measurements in the study were made from March until September, which may have affected the observations. Just doubling the costs obtained in the present study to obtain yearly costs could only be done with the uncertain presumption that costs are the same in the winter.

The measurement of productivity loss due to illness is highly dependent of the choice of approach, and this calls for standardisation on a national level (124).

5.2 General discussion of results

5.2.1 Interaction and professional skills

Study I

Niemeijer et al. (134) categorized two principles associated with treatment effects as "**giving instruction"** - giving clues, and adjusting body position. In study I the physiotherapist used instructions as: "*Let your arm fall through the bench*", categorised as word/image; a verbal expression and a metaphor, instead of giving verbal instructions, word/instruction, of how to slightly press the arm in extension. The underlying theory being that it is probably better to perform a movement without being too concerned about the body movements, as conscious control may interfere with control processes that would otherwise regulate the movement automatically (134, 148, 149). It may be better to "*just let go*", as instructed by the physiotherapist in study I. To direct the performer's attention away from the control of the movements and to the effects of those movements seems beneficial for a permanent effect on performance (150). An example given in paper 2 was the instruction to "*clap your thigh*" when pulling the elastic cord, instead of "lift your arm" (151), when the aim of the movement was to facilitate the automatic on-set of cuff activity in abduction.

Niemeijer et al (134) also registered how the physiotherapists focused on correction of body position, and physically guided the child to a favourable starting position, to make a desired action possible. This was in parallel with the manual positioning of the arm or the sling in our study, following Carr & Shepherd's principles on manual guidance (152). These motion adjustments were mostly obtained without verbal comments, as a prerequisite for pain free performance. Such instructions are in our experience not often included in exercise programmes.

Feed-back may have both an informational function and motivational properties (150). The use of the physiotherapist's hands in study I represents external feed-back. The meaning of this was to draw the patient's attention to a desired movement pattern. In practice this was interpreted as a manoeuvre that aimed at reducing activity in the upper trapezius muscle, or to enhance the activity in the posterior parts of the rotator cuff. Martin (85 p39) describes the use

of a finger or the whole hand as an "attention giving device", since the problem area is not visible for the patient. Other forms of external feed-back that have been used to promote a change in muscle activation particularly in the trapezius muscle, is biofeedback from surface electromyography (153-155).

Effenberg et al. (156) found that multimodal motor representations, consisting of at least visual, auditory and proprioceptive stimulation in combination, may result in more precise motor control and enhance motor learning. In study I the physiotherapist used her voice as a tool during hands-on and hands-off phases. The paralinguistic and the vocal expressions used to amplify an instruction during movement, and also the use of silence, are examples of this type of feed-back.

Talking about the motor task or movement execution with a child was categorized as "**sharing knowledge",** according to Niemeijer (134). This was also frequently observed in the present study, categorized as dialogue. The physiotherapist explained what was going on, the patient asked questions, the physiotherapist answered briefly, and asked the patient how he or she felt that the movement was performed. The reactions from the patient were used as information for further actions: "*I do not feel anything so let me know if you do"*. The patient's participation was invited in several ways as observed in the films, mostly in dialogue but also given the opportunity to swing the arm freely from time to time. In this way the physiotherapist tried to incorporate the patient's reactions with her own observations (83). Martin (85 p57) described this as "changing of participation": the patient is at first a learner, guided by a more experienced teacher, and gradually takes over the responsibility for the movement task.

Martin (85) considered the situation of motor learning as being part of a social process. The patient's attention was drawn to the location of the problem to be solved. In study I tapping, or knocking, on the shoulder was used to reduce activation of the upper trapezius muscle. The coactive collaboration between physiotherapist and patient in order to solve a problem together is what Martin described as a "repair process" (85 p52). The progression in the supervised exercises programme was made when the physiotherapist observed that the patient knew how to perform the movement. To make the patient know is part of this repair process. We used the expression coactive collaboration to underline that both the physiotherapist and the patient are encouraged to engage fully in the process.

The supervised exercises programme has been used for patients with subacromial pain at Oslo University Hospital, Ullevaal, for many years (55, 59) and the knowledge has been passed on to other physiotherapists. The traditional way to transfer practice knowledge among physiotherpists is learning by doing. Collins (157) and Roberts (158) discussed "how direct personal contact between expert and learner allows the passage of tacit knowledge. If this does not take place, there are two possible consequences. First, the tacit knowledge is simply lost. Second, given suitable opportunities, learners can reinvent the knowledge for themselves", as cited by Smith et al. (73 p327). Roberts (158 p433) concluded that "there are then elements of tacit knowledge, or know-how, which can only be transferred successfully through a process of demonstration, or show-how, facilitated through face-to-face contact between the transmitter and receiver". Observation has also been shown to be effective for motor learning (150). This implies that the implementation of an exercise programme requires some period of demonstration followed by practice. Learners must have some time to incorporate what is learned into their own practice (77, 159). They also need experience to handle what Schön called "indeterminate zones of practice" (135), "those areas of practice that are characterized by uniqueness or uncertainty or that involve a conflict of values", as cited by Jensen et al (132 p315).

The fact that the physiotherapist who performed the treatments in the present studies was not only competent but also highly specialized might have influenced the results. An example is the moment for decision when a patient should be sent back to the orthopaedic specialist for re-evaluation. Smith et al. (159 p405) characterized expertise as "true mastery, manifest in handling the patient (communicating, anticipating and minimizing discomfort) and recognizing limits of safe practice (knowing when to stop trying)". To detect confusion (133), what we called instances of non-learning in study I, and to distinguish normal from abnormal movement patterns (77) have also been identified as mastery characteristics.

Jensen et al (160) defined five attribute dimensions that distinguished the master clinician from the novice clinician in orthopaedic settings; one related to knowledge and four related to improvisational performance. They found experienced physiotherapists to be more responsive, they listened intently, and built on what the patient said. They frequently integrated verbal encouragement and tactile cues, for instance guiding the patient through a motion or an exercise while providing verbal encouragement (132). Payton (161) stressed the

conscious intentions of the physiotherapists sayings and doings, thus turning ordinary communication skills into professional communication skills. Potter found that patients most often attributed good experiences of physiotherapy treatments to communication ability (162). These factors may also have contributed to the results reported from studies with other exercise programmes.

5.2.2 Context

Study I

Context includes the organisational factors that precede the therapeutic intervention. The organisation of health care, the payment system, geographic location, cultural and social factors that surround our daily life will most likely influence the situation, but will not be further discussed in this thesis. The treatment situation in the present study was characterized by the positioning and the roles of the two participants. In the initial part of the supervised programme, the physiotherapist and the patient worked together during a session lasting for about an hour. Their positions would constantly change. Ek (75) described how two persons in face to face situations create and move in and out of different contexts through these changes, and how they constantly communicate about what is happening. Words may gain a particular meaning in and through the context (75, 85).

The treatment situation in study I is characterised by the patient lying down on a bench. The patient is undressed but covered with a blanket, and the physiotherapist is sitting on a chair beside the bench. This situation is characterized by the inequality between physiotherapist and patient concerning clothing, relative positioning and activity (83). The understanding how this asymmetry levels out was the focus of Martin's study (85). The physiotherapist assumes that she knows what the patient needs to learn, and the patient has consulted to seek help. This makes the physiotherapist responsible for the continuation of the actions. The patient's movements in this early phase of the supervised exercise programme were either passive, or actively assisted, and controlled by the physiotherapist. The physiotherapist was concerned that the patient felt safe and secure and attempted to guide motions that were not inhibited by pain. This was the content of the starting phase, the small talk that starts conversation, and proceeds to the task at hand (15). Adjustment of the sling is conducted in the start of the treatment session, when the roles of the two participants, the patient and the physiotherapist, are established. How they communicate will most likely affect the outcome of the process. As

progress is made the patient changes position from lying down to sitting and standing up to more challenging positions, as described in paper II (p4).

5.2.3 Outcome of the supervised exercises regimen

With the study design applied we did not evaluate possible structural changes in the tissues due to the intervention. We observed that good function can be restored after a few sessions. By example an 80 year old man recovered and scored 35p at the UCLA-score after seven treatment sessions during five weeks. A young man, 24 years old, followed exactly the same pattern. This suggests that recovery may be observed after a few treatments. The mechanism for the observed pain reduction was not evaluated. We may hypothesize that changes in motor activity of the shoulder muscles may reduce the mechanical subacromial pressure and that inhibition or influence of pain on central motor programmes may be altered, but this was not examined in the present study. Regeneration of tendon tissue is a slow process that is not likely to contribute to changes within seven weeks.

A recent systematic review reported a difference in the activity of the upper and lower trapezius between people with subacromial pain and healthy controls (163). The changing of motor patterns and the coordination of shoulder muscles may facilitate reduction of pain. We may hypothesize that muscle activity was altered in the patients who improved, but this was not examined.

Physiotherapy treatment may serve several aims. In a study (164) with a similar design as study II, patients with a degenerative lumbar disorder selected for spinal fusion surgery, were invited to participate in a cognitive behavioural intervention including individual physical exercises and group exercises. The goal was to let the patients experience that it is safe to move. At follow-up, 21 (42%) patients wanted surgery, 8 (16%) were uncertain, and 18 (36%) did not want surgery. Age, gender, emotional distress, intensity of pain, neurological or radiological signs or the number of exercise sessions taken did not influence the results. Several studies have shown a relationship between pain-related fear and shoulder disability (165-167).

5.2.4 Consequences for management strategies

Study II

The observed increase in shoulder surgery does not correspond with a reported increase in prevalence of shoulder pain (18, 19, 21) nor the current evidence on its effectiveness from three randomised clinical trials. Hofmann (168) argued that there is a technological imperative in healthcare, and Epstein (108 p269) argued that "administrative efforts are more likely to be focused on decreasing inappropriate care than on increasing access to beneficial procedures". A Cochrane review (61) suggested that the decision to undergo surgery may depend upon patient preference or failed non-operative treatment, or both. Contrary, the lack of effectiveness of surgery as compared to exercises have challenged researchers in the shoulder surgery setting to evaluate the effectiveness of arthroscopic subacromial decompression in comparison with placebo, and two study protocols have been presented (169, 170).

In the present study patients were selected for surgery following common procedures. The question about which patients should have surgical treatment and which should have physiotherapy was not assessed in the present study. However, the fact that the majority of the patients indicated for surgery in the present study declined surgery after having fulfilled the supervised exercise programme, questions not only the indications for surgery but also the quality of the conservative treatments that these patients previously had taken.

Despite the limitations of the design and conduction of study II, results are in agreement with the three previously published and cited trials on surgery versus exercises in that most patients with subacromial pain referred for surgery are managed satisfactory by an exercise regimen. Moosmeyer et al. (171) found in a randomised study that even among patients with small and medium-sized rotator cuff tears, 42 out of 51 patients (82%) that were allocated to a supervised exercise programme accepted the result achieved by physiotherapy as their final result. The clinical, non-structured follow-up of the ten patients that had surgery in study II (Appendix1) revealed that only half of these patients recovered, in some cases after a long rehabilitation period (10 months).

In a Swedish study (172) 105 patients were investigated 8-11 years after arthroscopic subacromial decompression. There was no control group. Sixty-one patients (58%) stated that

they were very satisfied and 27 (25%) that they were quite satisfied with current shoulder function. Half of the group had physiotherapy for more than 2 months post surgery. The cost for one operation in study III was set at €2420, and post-operative rehabilitation including sick leave are additional costs.

The difficulties related to clinical guidelines for patients with subacromial pain are related to the complexity of the diagnoses and the variety of physiotherapy interventions used. Guidelines are in general designed to help practitioners and patients to make decisions about appropriate health care for specific conditions (173). The aim of guidelines for physiotherapists is to reduce differences in treatment and enhance uniformity in the profession; to show the tasks and responsibilities of the profession; and to stimulate collaboration with other health care professions.

A draft guideline should be tested or reviewed for validation, which is seldom done due to lack of money and time (173). The supervised exercise regimen applied in the present study (I and II) has been repeated in different randomised studies, which demonstrates its clinical applicability (55, 57). Thornquist (83) and Niemeijer (148) both reported that physiotherapists who had the same training practiced differently. We still do have limited knowledge about which part of the programme that is most important. Home exercises may be effective (46, 47, 174) and other standardised exercise programmes have been reported to be effective (54, 56, 175). From the description of the intervention it is not easy to interpret major differences between the programmes. The type of exercises, the number of repetitions, the type of muscular contraction, the number of sessions per week, and the total treatment period are emphasized, while other factors such as communication with and motivation of the patient, are less often reported. An actual hypothesis in future research could be that the communication skill is an important aspect?

The increase in surgery despite the results of the randomised trials may reflect that the general outcome of physiotherapy in patients with subacromial pain in primary care is inferior to the results from randomised trials conducted in the hospital setting. However, this has not been evaluated in clinical trials. Considering the results from the present study and previously reported clinical trials, physiotherapy organised in setting of a shoulder surgery outpatient clinic may be cost-effective from a societal perspective and from the patient perspective. Patients' acceptance is important when clinical guidelines are developed (173). Seventy of the

72 patients who fulfilled the supervised exercises in study II were reported that they would recommend this programme to other patients. Cost effectiveness is important for implementation of a treatment strategy (170). Whether an intervention programme is cost-effective or not depends on clinical outcomes and the costs needed to achieve this (14). Such studies are extensive and time consuming, but study protocols are presented (176-178).

Study III

The mean healthcare costs contributed to a minor percentage of the total costs, while the median costs were comparable: median healthcare cost was €200 (Inter Quartile Range 113-397) and the median total cost was €249 (IQR 119-661). This reflects that a minority of patients incur high costs from long lasting sickness absence. These findings are in keeping with previously published results on patients with shoulder and back pain (110, 179, 180). Patients with known prognostic factors for longstanding pain, such as heavy medication, comorbidity and long periods of sick-leave (2, 181), can be identified from diagnostic codes in electronic patient records. It may be questioned whether more resources or different strategies directed to these groups could lower the costs. Several studies have reported that long-term sickness absence was associated with work conditions rather than with individual characteristics (2).

A sensitivity analysis showed that the physiotherapy unit cost made the biggest contribution to uncertainty in the health service cost. A 30% change equals a change of health care costs of 18%. It also showed that the total cost was most sensitive to the choice of method for estimating the sick leave cost. Using the friction cost method gave a reduction of the total cost per patient of 51.6% of €1001 that was estimated by the human capital approach. Because of the dominance of the sick leave costs to the total costs, changes in healthcare costs had just a minor direct influence on the total cost.

Nine out of 19 patients who had surgery in study III had physiotherapy for more than six months. Alternatively, the average cost of 11 physiotherapy treatments was €550 for one patient. In the present study, 89% were diagnosed with subacromial or nonspecific shoulder pain. Feleus et al. (65) found that 41 % of the patients with non-traumatic neck, arm, or shoulder pain were given an unspecific diagnostic code at the first consultation in primary health care. A specific diagnosis was given in 59% of the cases, mostly subacromial

impingement syndrome, but no differences were found in severity, complaints or functional limitations between the groups. Patients with specific diagnosis were more frequently referred for specialist treatment, while patients with non-specific diagnoses were more frequently referred for physiotherapy in the Dutch study (65).

Ultra-sound was used in 23 cases (11%) in study III, most often in combination with x-ray, whereas in study II MRI was used more frequently. We estimated in study III that ten MRI investigations would be performed for the 29 patients that were referred to secondary care. However, the use of MRI varies from region to region and from country to country. Estimated costs for secondary care increased the total costs by at least one third for the selected group in study III. Physicians or physiotherapists in primary care may provide ultrasound imaging. It may be questioned whether this is a good strategy. This may be addressed in cost-effectiveness studies and in addition will depend on the reliability and validity of ultrasound assessments in primary care. Studies have shown that in a radiology department setting ultrasound imaging can be considered almost equally effective in detecting partial tears of the rotator cuff and biceps tendon (68, 69) and in full-thickness tears (67) compared to MRI, and it is cheaper.

Incidental findings of structural abnormalities on MRI of the knee (182) and shoulder (183) in the general population are common and increase with age, which means that costs will continue to rise with an ageing population despite that the interpretation of findings are difficult. Also, early investigations might lead to increased rates of referrals to specialists. According to one study, MRI should only be used when surgery is considered (184). If MRI is limited to surgical patients costs related to surgery will increase as compared with non-operative treatment. However, it is our experience that in many regions in Sweden and Norway MRI is used extensively in patients with chronic shoulder pain treated non-operatively. Another study found that patients preferred ultrasound to MRI (185), and patient acceptance is of importance for clinical guidelines (173)

5.3 Clinical implications and further research

The video analysis of the initial part of the supervised exercise programme revealed elements that differ from other programmes. The unloaded position with the arm in a sling may particularly be beneficial in an early, painful phase. However, the exact mechanism for an eventual pain relief is not understood at present. We may hypothesize that sling exercise therapy may affect the local connective tissue as well as pain mechanisms at the central level. The concept of unloading or loading, against gravity or resistance, should be explored further (186, 187). Eccentric loading may contribute to pain relief (187, 188) and tissue healing (189). Supervised exercises may be beneficial also for other patient categories, by example patients with non-specific shoulder pain.

The supervised exercise intervention has not been evaluated in the primary care settings. Since most patients with shoulder pain in primary health care are classified with subacromial pain according to one article (190), the programme may be beneficial for a large group of patients. RCT is the gold standard design for studies in primary care settings, and may be conducted as multi-centre studies in order to include a sufficient number of patients.

Future studies should include cost-effectiveness evaluation of various physiotherapy regimens or comparisons of physiotherapy with other treatments for shoulder pain.

6. CONCLUSIONS

The method applied in study I should be further developed to highlight the coactive collaboration between physiotherapist and patient, which cannot be learned from a simple manual including different exercises for use in patients with shoulder pain.

The initial part of the supervised exercise programme aims to re-track the normal pattern of movement in arm elevation. A specific technique based on knowledge, communication skills, manual skills, and coactive collaboration, is applied. The what, why, and how in a supervised exercise programme may be equally important.

The majority of patients with subacromial shoulder pain who were candidates for surgery declined surgery after having fulfilled in average 11 sessions with the supervised exercise programme. This suggests it feasibility in a local hospital.

Cost evaluations based on electronic patient records can be used in primary health care. Diagnostic codes, costs and costing methodology should be standardised to allow comparisons between different regions and changes over time. The most important factor contributing to total costs was sick leave. Physiotherapy accounted for about 60% of treatment costs. Costly imaging was rarely used, but had major impact on health care costs when used in individual patients.

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APPENDIX

Patient	Rot.cuff or Biceps tendinitis	Bursectomy	Full ROM after	New contact, new problem	New contact, same problem	Training sum, results	Recovered
M 43	B	X		After2years		5	No info
M 39	B	No	Yes, but disturbedrythm	Yes	After2years	8, No change	No
M 49		X	Yes			9, No change	Yes
M 46	AC-joint	No		Other shoulder after 5 years		8	Yes
F 61	RC	X	Painfree after anaesthesia			4, Worse	Yes after 10 months
F 42		X	Pain at abd	Both shoulders	Yes	14, Better	Expected
M 58						24, fullfilled	No info
F 60						11	Yes
F 37			Yes	Yes		8, Worse	No
M 52				Yes		3, Worse	No

Table 2. Follow-up after surgery. N=10 patients

All patients had subacromial decompression performed with open or arthroscopic approach, with or without bursectomy. No tendon repairs were made. Notes of findings at surgery, active range of movement and scapula-humeral rhythm after surgery was found in some cases. M=males, F=females, followed by age. The amount of training sessions has been added.

Errata

The following references in the text should be corrected:

2.1.3 Surgery (pp.16-17):

About 6,500 shoulders were operatively treated in Sweden in 2004, and since 1998 there has been an annual increase of about 10% (64). A recent study reported a four-fold increase in the number of acromioplasties for rotator cuff disorders of the shoulder in New York State from 1196 to 2006 (11)….Although evidence from case series supports surgical interventions for shoulder pain when used appropriately (38)….

2.3 Qualitative studies (p.19)

Only a few video studies were found in this field ….In this tradition learning is described as a coaction that is bound to a particular situation and context (75, 77, 85).

2.5.1 Outcomes research (p.21)

Donabedian (103) defined quality of care…

5.1.3 Design: strengths and limitations, study III (pp.42-43)

However, self-reported data on days of sick leave (141), and number of physiotherapy contacts have been reported to be less valid than register-based data, whereas specialist care contacts were generally in agreement with data from an insurance company (141).

The following text should be corrected:

p.31, Study III first line :
…we constructed *a spreadsheet-based economic model* including data from…

p.35, Study III second line:
Nineteen (9%) of these had been operated on…

p.42, second section first line:
The fact that the patients had to pay for physiotherapy, but not *after* surgery,…

I

II

III

Virta et al. BMC Musculoskeletal Disorders 2012, 13:17
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RESEARCH ARTICLE Open Access

Costs of shoulder pain and resource use in primary health care: a cost-of-illness study in Sweden

Lena Virta[1*], Pål Joranger[2], Jens Ivar Brox[3] and Rikard Eriksson[2]

Abstract

Background: Painful shoulders pose a substantial socioeconomic burden. A prospective cost-of-illness study was performed to assess the costs associated with healthcare use and loss of productivity in patients with shoulder pain in primary health care in Sweden.

Methods: The study was performed in western Sweden, in a region with 24 000 inhabitants. Data were collected during six months from electronic patient records at three primary healthcare centres in two municipalities. All patients between 20 and 64 years of age who presented with shoulder pain to a general practitioner or a physiotherapist were included. Diagnostic codes were used for selection, and the cases were manually controlled. The cost for sick leave was calculated according to the human capital approach. Sensitivity analysis was used to explore uncertainty in various factors used in the model.

Results: 204 (103 women) patients, mean age 48 (SD 11) years, were registered. Half of the cases were closed within six weeks, whereas 32 patients (16%) remained in the system for more than six months. A fifth of the patients were responsible for 91% of the total costs, and for 44% of the healthcare costs. The mean healthcare cost per patient was €326 (SD 389) during six months. Physiotherapy treatments accounted for 60%. The costs for sick leave contributed to 84% of the total costs. The mean annual total cost was €4139 per patient. Estimated costs for secondary care increased the total costs by one third.

Conclusions: The model applied in this study provides valuable information that can be used in cost evaluations. Costs for secondary care and particularly for sick leave have a major influence on total costs and interventions that can reduce long periods of sick leave are warranted.

Background

Shoulder pain is a common cause of lost work days and disability. A majority of the patients are treated in primary health care [1-3]. In Sweden, health and medical care are organised in three levels: regional medical care, county medical care, and primary care which is organised by the county councils. Primary care is intended to meet the needs of most patients for medical treatment, care, preventive measures and rehabilitation. When more specialised care is necessary, patients are referred to the county hospitals. The regional hospitals treat rare and complicated cases. There were very few private care providers in the county at the time of this study. Resources are scarce, and the Swedish Health and Medical Services Act states that priority should be given to those who are in the greatest need of health and medical care. Quality of care can be defined as a combination of structure, process, and outcome [4]. Cost-of-illness studies can provide information about healthcare resources and costs allocated to different groups of patients.

Net costs to healthcare authorities for health and medical care in Sweden in 2005 were 16% for primary care and 52% for specialised physical care [5], most of which is financed from tax revenues. There is a government-imposed patient's cost ceiling for health care, meaning that no patient needs to pay more than €100 during a 12-month period, and no patient needs to pay more than €200 for prescription drugs covered by the benefits.

About 6,500 shoulders were operatively treated in Sweden in 2004 [6], and since 1998 the number of shoulder surgeries has increased by about 10% annually. A recent study reported a four-fold increase in the number of acromioplasties for rotator cuff disorders in New York

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State from 1996 to 2006 [7]. Multifactorial reasons were suggested for this increase, with patient-based, surgeon-based, and systems-based factors all playing a role. The differential diagnoses for shoulder pain are based on the history, acute or chronic nature of the pain, physical examination, and, if needed, completed with imaging. Tests for diagnostic accuracy [8] as well as surgical indications, are being discussed [1,9,10]. Although evidence from case series supports the effectiveness of surgical interventions for shoulder pain when used appropriately [1], the increase in shoulder surgery cannot be explained by the practice of evidence-based medicine. Three randomised clinical trials [11-13] comparing supervised exercises for subacromial pain with surgery, have concluded that supervised exercises are equally effective as surgery - and less expensive. One additional study found that only 10% of the patients awaiting surgery were finally operated on after being treated with physiotherapist-supervised exercises in a hospital setting [14]. This indicates a need for economic evaluations of current treatment strategies in primary health care.

The initial steps taken to diagnose and treat the patient in primary care may be essential for effective treatment, and may contribute to fewer patients being referred to surgery as well as lower costs to society. Kuijpers et al [15] reported costs of shoulder pain in primary care patients who presented with shoulder pain to their general practitioner (GP) in the Netherlands in 2006. Patients were followed for six months and their shoulder pain related costs were calculated by using patients' cost diaries. The patients reported all expenses relevant to their shoulder complaints; direct costs, such as visits to healthcare centres, and indirect costs, such as sick leave, and paid and unpaid help. In their study, 70% had persistent symptoms after six weeks and 46% after six months. They found that 12% of the patients with shoulder pain were responsible for 74% of the total costs, mostly a result of sick leave from paid work. Our study was performed to investigate the situation in Swedish primary health care, using an alternative design.

In Sweden, electronic patient records (EPR) based on diagnostic codes are used mainly in the clinical care of patients and rarely to evaluate healthcare programmes or cost-effectiveness aspects. Completeness and accuracy of diagnostic codes have been found acceptable [16,17], in spite of a coding system poorly adapted to primary health care. Attempts have been made, using EPR, to monitor the burden of illness for patients with low back pain [18], diabetes [19], and groups of patients according to their health status [20]. Linking costs and consequences based on already collected patient data may be useful to monitor the cost of illness in selected groups of patients.

The aim of this study was to assess the costs associated with healthcare use and loss of productivity caused by shoulder pain in Sweden, by auditing data from the EPR.

Questions asked in the study:

- What are the shoulder pain related treatment costs in primary care consulters in Sweden (direct costs)?
- What are the costs of shoulder pain in defined subgroups of the selected population (highest costs)?
- What are the costs for sick leave (indirect costs)?
- What are the total costs?

Methods

Setting

The study was performed in 2009 in two municipalities, comprising 24 000 inhabitants, in a prosperous region on the Swedish west coast. The labour market in this region is based on trade and tourism, as well as many small and medium-sized enterprises. Three primary healthcare centres with three adjacent physiotherapy units were responsible for almost all primary health care in the area. There were few private alternatives to physiotherapy and no private physicians, making it possible to capture almost all patients who presented with shoulder pain in primary health care. In western Sweden, patients do not need a referral for physiotherapy. Sick leave for more than eight days must be prescribed by a doctor, although some employers require this from day one. The inclusion of patients was based on EPR in primary health care. We included all patients that presented with shoulder pain to any of these six units during the measurement period of six months, regardless of trauma or other diseases. Patients being permanent residents in either of the two municipalities and between 20 and 64 years of age were included, if any of the diagnostic codes given at the visit qualified them.

Costing

A prospective cost-of-illness study was performed to explore the most important cost components of treating shoulder pain in primary health care. Healthcare costs and total costs, including cost for sick leave, were assessed. Costing involves identifying, measuring and valuing all resource changes that occur as certain healthcare interventions are carried out. In a bottom-up approach, individual elements are specified in detail. The three steps of the costing procedure in this study were:

1. Identification of relevant cost-items
2. Quantification of the use of the identified cost-items
3. Valuing the identified items

Electronic patient records (EPR)

With very few exceptions, all units in primary health care in Sweden are computerised, and several EPR systems are in use. The data collected from the EPR were organized in a data matrix containing patients' personal

identity number, age, sex, dates of encounter and diagnostic codes for every visit, number of admissions and referrals to specialist care, x-rays, number of drug prescriptions and sick leave periods prescribed by a GP. Our first step was to retrieve all visits to general practitioner or physiotherapist (PT) caused by shoulder pain during the measurement period. All data were anonymised before analysis.

At all participating units, notice boards were used to inform the patients. Receptionists were also asked to leave information sheets to patients who sought treatment for shoulder pain. All inhabitants in the area had been told that information from their EPR could be accessed and processed without consent for planning and quality assurance. The procedures of this study were approved by the Regional Ethical Review Board of Gothenburg.

Management of shoulder pain

The Swedish guidelines for the management of shoulder pain [6] are similar to those for GPs in other countries [15,21-23]. Conservative (non-operative) care is recommended, including information on the prognosis of shoulder pain and advice regarding physical activities. In addition, the guidelines recommend a step-by-step treatment progression, consisting of physiotherapy treatment, pain relief and glucocorticoid injections (administered with or without local anaesthetic). If conservative treatment fails to reduce the symptoms, the patient is referred to an orthopaedic surgeon. In the present study physiotherapy treatments were adapted to each patient's condition and supervised exercises were emphasised.

The local hospital has a radiology department providing ultrasound evaluation of suspected tendon ruptures. MRI is regarded as a tool for orthopaedic surgeons and is seldom used in primary care in this part of Sweden.

The diagnostic coding system International Classification of Disease, version 10 (ICD-10), was used. Initially, a pilot study was performed at all six participating units to find out which diagnostic codes that were used for patients who consulted for shoulder pain. Fractures and dislocations of the shoulder were included. All visits with known and potential codes for shoulder pain were retrieved from the EPR system. Each individual with a potential code was scrutinized by comparing data within the EPR to verify the cause of visit. In the last step, 29 codes were classified in four categories, presented in Table 1: subacromial pain (including nonspecific shoulder pain), stiffness (adhesive capsulitis, arthritis), dislocations, and fractures.

Procedure

The cost-of-illness calculation was based on all registered actions related to shoulder pain during the measured period. Patients referred to orthopaedic surgeon for evaluation were followed up to monitor whether they were selected for surgery or not.

Total treatment time and sick leave at inclusion were retrieved from the EPR. The period between first and last dates of visit to a GP or a PT with the qualifying code was defined as the total treatment time. At least one visit per month had to be registered, except during the holiday period.

Half of the patients started and ended treatment within six months. Some started before and some ended after the measured period. We believe that this would be the case at any chosen period during the year. Costs for all patients passing through during six months can be multiplied by 2 to estimate the annual cost for this group of patients. This estimate can then be used to compare with annual costs in other regions. This method is also suitable to investigate the relative size of the different treatment components.

Calculation of treatment costs per patient requires complete registration of all activities during the whole treatment period. Patients must be monitored from their first encounter for shoulder pain, although onset may be difficult to define. They should preferably be monitored for a long time period, ideally for the rest of their lives.

Table 1 Diagnostic codes.

Subgroups	Diagnostic codes	Patients N (%)	Age (years) Mean (SD) Median	Sex: Male N (%)	Had Surgery N (%)
Subacromial pain	M751-9, M759P, M709, M779, M791, M799, M255, M255B, M629, M795, M796B	181(89)	48 (11) 51	89(49)	9 (48)
Stiffness	M750, M190B, M192B	10 (5)	52 (10) 54	7 (70)	2 (10)
Fractures	S420, S4200, S429	7 (3)	48 (14) 52	3 (42)	6 (32)
Dislocations	S430, S431, S435, S460	6 (3)	51 (13) 55	2 (33)	2 (10)

According to International Classification of Diseases, version 10 (ICD-10), used for shoulder pain and merged into four categories. Code names are presented below. All patients, N = 204. Patients who had surgery or other orthopaedic intervention, N = 19

M75. Shoulder lesions; M750 Adhesiv capsulitis

M70-M79 (B) Other soft tissue disorders (shoulder); M629 Disorder of muscle

M255 (B) Pain in joint (shoulder); M19.(B) Arthrosis (shoulder)

Valuing healthcare costs

Costs used in the economic evaluation are presented in Table 2. Healthcare costs per visit to GP were in our study set at €107. This figure was based on reports from the National Board of Health and Welfare, in which the cost was calculated to €92 in 2004, costs for medication and medical services *excluded*. To this we added an annual increase in costs of 3%. We compared this with the local inter-county price list in Sweden for 2009 [24], where a visit to GP, *including* x-ray, medication and laboratory services, was charged with €124. From these figures we found our estimate per visit to be appropriate. We used the cost for physiotherapy treatment, €50, from the same inter-county price list, since no other figures were available. Charges to primary care for x-ray and ultrasound evaluations were retrieved from the hospital's radiology department.

Medication prescribed during the registered visits was retrieved from the EPR. Medication purchased without prescription was not registered. Costs for analgesics and nonsteroidal anti-inflammatory drugs were calculated as if every prescription was filled once and as if the patient had free medication, meaning that the costs were paid by the primary care unit. Costs were retrieved from the hospital pharmacy.

Patients who were referred to an orthopaedic specialist and to surgery generated additional costs. From the local inter-county price list [24] and the hospital administration we retrieved the costs for visits in outpatient care and a mean cost for ambulatory surgery in 2009, based on actual costs per patient. We estimated that ten MRI investigations would be performed in the patients evaluated in the present study. These figures illustrate the higher costs for secondary care (Table 2).

Table 2 Costs used in the economic evaluation

Costs	(Euros*)
Direct healthcare costs (per visit)	
General practitioner (25 min)	107
Physiotherapist (60 min)	50
x-ray, shoulder	65
Ultrasonography, shoulder	124
Medicine	Prices July 2009
Orthopaedic specialist	335
MRI	308
Shoulder surgery, uncomplicated, ambulatory care	2420
Indirect costs	
Sick leave from paid work (human cost method) per day	205

*1 Euro = 10.62 SEK. Average values in 2009, http://www.riksbank.se (Swedish National Bank)

Valuing productivity costs

The costs for sick leave were for the baseline value calculated according to the human capital approach [25,26]. This method places monetary weights on healthy time using market wage rates. It is an estimation of changes in productivity, based on the opportunity cost of the production that people would have contributed to, had they been at work. We assumed that the production costs were reflected by the salary. In this study, we only had data on sick leave periods (graded from 25 to 100% of full working time) prescribed by GPs. Partial sick leave was converted to 100% sick leave for each patient. The cost per day was calculated from the mean income in the region in 2008, provided by the Swedish Bureau of Statistics. The costs for productivity loss due to sick leave were calculated after this model presented by the Swedish Ministry of Industry in 2001 [27]:

Costs for productivity loss = Mean income + social fares + indirect taxes.

We assumed that social fares were 40% of the main cost and indirect taxes were 28%.

This equation shows what the worker must produce to cover his own income, payroll taxes and fees by law and agreement.

Human capital versus friction cost method

An alternative approach to the human capital method is the friction cost method [25,28]. In that case we assume that when a person has a period of sick leave, there is a pool of unemployed people that can replace the sick person. Hence, there will only be a productivity loss in a "friction" period until the new employee is recruited and trained to do the job. It is frequently argued that evaluations using the human capital approach overestimate the true costs to society [25]. Koopmanschap et al [29] found that cost of absence from work in 1988 when using the friction cost method was 38.7% of what they found by using the human capital approach. The cost for disability was 0.3% and for mortality 1.9% if the friction cost method was used. As part of the sensitivity analysis we displayed the effect of using the friction cost instead of the human capital method.

Data analysis

Costs were calculated for a six-month period. The arithmetic mean, standard deviations (SD), and median value were used to provide information about the total cost of treatment for all patients, and to illustrate the skewness in the distribution of costs and resource use. The total costs during six months, were multiplied by 2 in order to get the total annual costs for patients with shoulder pain in primary health care.

One-way and two-way sensitivity analyses were performed to explore the uncertainty [30], to demonstrate the impact of one parameter varying in the model, and to examine the relationship of two or more different parameters changing simultaneously.

We used a multivariable linear regression analysis to explore how gender, age and municipality, as independent variables, predicted costs.

Results

Patients

During six months 204 patients were registered; 103 women and 101 men. Mean age was 48 (SD 11) years. Eighty-nine per cent presented with subacromial or non-specific shoulder pain (Table 1). Nineteen patients (9%) came for postoperative rehabilitation. Twenty-nine patients (14%) were referred to an orthopaedic surgeon, and four of these (2%) went on to have surgery within a year. Fifty per cent of the cases were closed within six weeks, whereas 32 patients (16%) remained in the system for more than six months. Seven of these patients had been operated on. Baseline characteristics of the group are presented in Table 3.

Use of healthcare resources and sick leave

Consumption of healthcare resources and sick leave from work during six months are presented in Table 4. Forty patients (20%) had a period of sick leave prescribed by GP, mean 9.0 days (SD 29.2). Three patients (1.5%) were on sick leave due to their shoulder pain for more than six months; two of them with concomitant back pain and one with concomitant diabetes. Partial sick leave amounted to 11% (202 days) during the measured period.

Fifty-five patients (27%) consulted both a GP and a PT within 4 weeks. Nineteen patients (9%) had more than 10 physiotherapy treatments, 68 patients (33%) had none. The whole group had a mean of 6.7 (SD 7.0) physiotherapy treatments and 24.0 (SD 50.2) days of sick leave.

The consumption of medication, x-ray and ultrasound evaluations was low.

Costs

Costs for healthcare use and sick leave are presented in Table 4. The mean healthcare cost per patient was €326 (SD 389). Physiotherapy treatments accounted for 60%. This cost was twice as high as for visits to GP. The group of 73 patients that used the direct access to PT incurred a higher mean total cost for physiotherapy but lower healthcare and total costs.

The healthcare costs for the group with persistent symptoms were one fourth of all healthcare costs during six months. Median healthcare costs were €200 (Inter Quartile Range 113-397) for the whole group, whereas the median total costs were €249 (IQR 119-661). Eighty-four per cent of the total costs were due to sick leave prescribed by GP, for the whole group and for those who had surgery.

Total costs for the 45 patients (22%) with costs > €1000 during six months are presented in Table 5. Sick leave in this group amounted to 91% of the total costs, and for 44% of the healthcare costs (Figures 1 and 2). Seven patients in this group had no registered sick leave. Eighteen patients had symptoms for more than 6 months; five of them had no registered sick leave. The three patients with sick leave > 6 months contributed to 25% of the total costs.

Table 3 Baseline characteristics of patients with shoulder pain.

Characteristics	n = 204	n = 45*	n = 19**
Age (years); mean (SD)	48 (11)	48 (11)	48 (13)
Sex: male; n (%)	101 (49)	20 (44)	10 (51)
Treatment duration of current shoulder complaints***			
0-6 weeks	101 (50)	15 (33)	4 (21)
7-12 weeks	28 (14)	4 (9)	2 (10)
12-26 weeks	42 (21)	12 (29)	6 (32)
> 6 months	33 (16)	14 (29)	7 (37)
Duration of sick leave in the 8 weeks preceding inclusion****			
0 weeks	193 (95)	37 (82)	17 (89)
0-1 weeks	4 (2)	3 (7)	1 (5)
1-8 weeks	7 (3)	5 (11)	1 (5)

Numbers (percentages) are presented unless stated otherwise

* patients generating costs of > €1000 in 6 months

** had shoulder surgery

*** total treatment time for all patients. Costs calculated for 6 months

**** sick leave due to shoulder pain

Table 4 Costs (€) and consumption of healthcare resources and sick-leave during 6 months.

Direct costs	Mean number of visits	Total number	Cost per patient	Total costs
General Practitioner	0.89 (0.97)	181	95 (105)	19429
Physiotherapy	3.91 (7.40)	798	195 (369)	39825
X-ray*	0.28 (0.45)	57	18 (29)	3719
Ultrasound*	0.11 (0.31)	23	14 (39)	2857
Medicine*	0.28	58	4 (6)	718
Total healthcare costs			**326 (389)**	**66548**
Indirect costs				
Sick-leave**	9.04 (29.17)	1844	1743 (5626)	**355610**
Total costs			**2069 (5730)**	**422158**

N = 204. Means (SD) or total numbers are presented

* Number of patients given prescriptions for medicine, x-rays or ultrasound

** Days

The mean annual total cost for patients with shoulder pain in primary health care was €4139 per patient. Additional healthcare costs were generated by 29 patients (14%), MRI investigations, and from four cases of surgery in ambulatory care. The costs for secondary care for this group were estimated at €22475, corresponding to one third of the total costs for primary care.

Uncertainty

To show the uncertainty of the results we have reported the 95% confidence interval (CI) for the base case scenario for total costs and for healthcare costs in Table 6. The CI is €1 283- 2856 and €273-380, respectively. These intervals reflect the uncertainty caused by the fact that different patients use services such as x-ray and PT consultations with different *frequencies*. Additional uncertainty is related to the *cost per unit* of health services and the cost of sick leave per day. To show the importance of this uncertainty we performed a sensitivity analysis. For x-ray cost per examination we chose as an example +30% as a maximum average value and -30% as a minimum value. For each tested parameter value we computed the new expected costs and 95% CI based on the sample variation related to the (unchanged) frequencies of health service use and the new cost level per unit. The sensitivity analysis showed that the total cost was most sensitive to the choice of method for estimating the sick leave cost. Compared to the base case scenario where we used the human capital method, the friction cost method gave a reduction of the total cost per patient of 51.6% to €1001. Because of the dominance of the sick leave cost, the reasonable change of healthcare cost has just a minor influence on the total cost. A 30% change in physiotherapy cost or a 50% change in physician cost contributes just to a 2.8 and 2.3% change in the total cost, when changing these parameters one by one (one-way sensitivity analysis). When changing all the parameters of health service cost in the same direction (multi-way sensitivity analysis) as shown in Table 6, the total cost only changes by 5.7%.

The sensitivity analysis showed that the physiotherapy unit cost makes the biggest contribution to uncertainty in the health service cost. A 50% change in the

Table 5 Costs (€) and consumption of healthcare resources and sick-leave during 6 months for the group that cost > €1000.

Direct costs	Mean number of visits	Total	Cost per patient	Total costs
GP	1.71 (1.42)	77	184 (153)	8266
PT (cost per visit)	8.20 (13.62)	369	409 (680)	18415
X-ray*	0.33	15	22 (31)	979
Ultrasound*	0.27	12	33 (56)	1490
Medicine*	0.47	21	6 (7)	262
Total healthcare costs			**654 (671)**	**29412**
Indirect healthcare costs	Days			
Sick-leave**	40.82 (50.98)	1837	7875 (9833)	**354356**
Total cost			**8528 (9829)**	**383768**

N = 45. Means (SD) or total numbers are presented

* Number of patients given prescriptions for medicine, x-rays or ultrasound

** Days

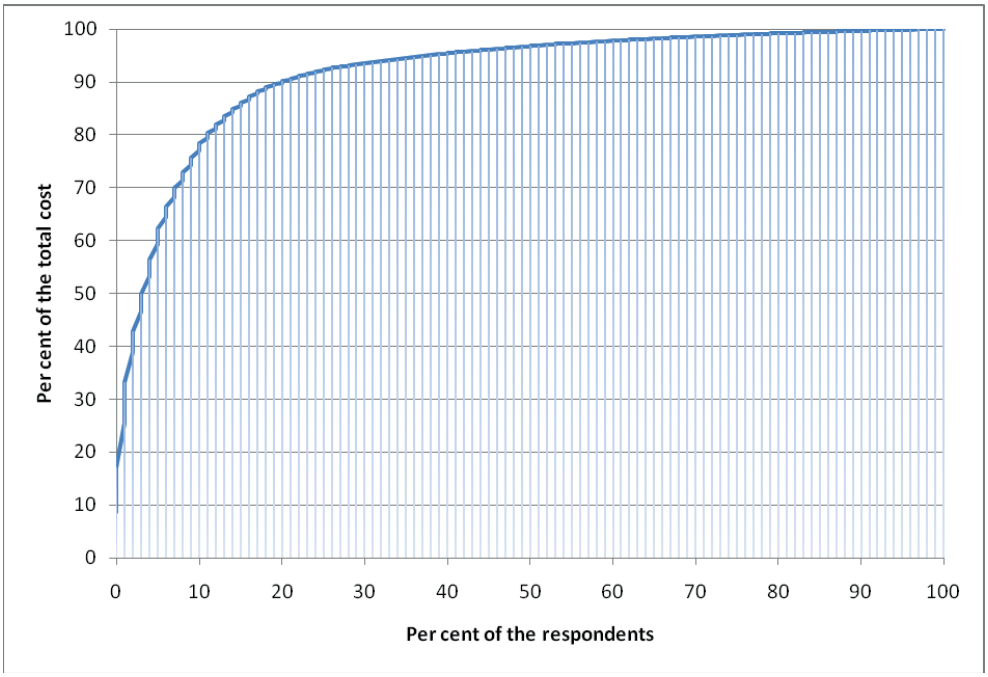

Figure 1 Distribution of total costs.

physician unit cost changes the health service cost by 14.6%, and a 30% change of physiotherapy costs gives a change of 18.0%. Relevant changes in the costs of x-ray, ultrasound and medicine only have a minor influence.

Gender, age and place of treatment did not influence total costs or health service costs. A sensitivity analysis using the logarithm of total cost and health service cost did not change this conclusion (Table 7).

Discussion

The main finding in the present study is that the mean healthcare costs amounted to less than 20% of mean total costs for patients with shoulder pain. Contrary to this, median healthcare costs contributed to 80% of median total costs, reflecting a minority of patients incurring high costs from long lasting sickness absence. Our findings are in keeping with previously published results on patients with shoulder and back pain [15,18,31].

Treatment strategies

The majority of patients were managed in primary care. Fifty per cent were treated within six weeks, and only two per cent were selected for surgery. This is in line with the intentions in guidelines and literature. Surgery should be considered if it represents an evidence-based approach when conservative measures fail. A treatment strategy for patients with subacromial pain is currently evaluated [32]. The observed increase in shoulder surgery does not correspond with a similar increase in prevalence of shoulder pain [33]. Vitale et al [7] discussed the increasing utilization of surgical procedures overall in recent years, and Hofmann [34] argued that there is a technological imperative in health care.

The inter quartile range of total costs varied from 119 to 661, illustrating the impact of long periods of sick leave. A fifth (22%) of the population generated costs of more than €1000 and accounted for 91% of the total costs. In the Dutch study [15], 12% of the patients cost more than €1000 and contributed to 74% of the total costs. The three patients with sick leave > 6 months contributed to 25% of the total costs. Efforts have been made to reduce long periods of sick leave, often combined with programmes for pain management [35-37]. Multidisciplinary rehabilitation programmes for patients with chronic low back, neck or shoulder pain are reported to be superior to treatment as usual for return to work [38,39]. However, a Cochrane review [40] on the subject did not find evidence to recommend multidisciplinary

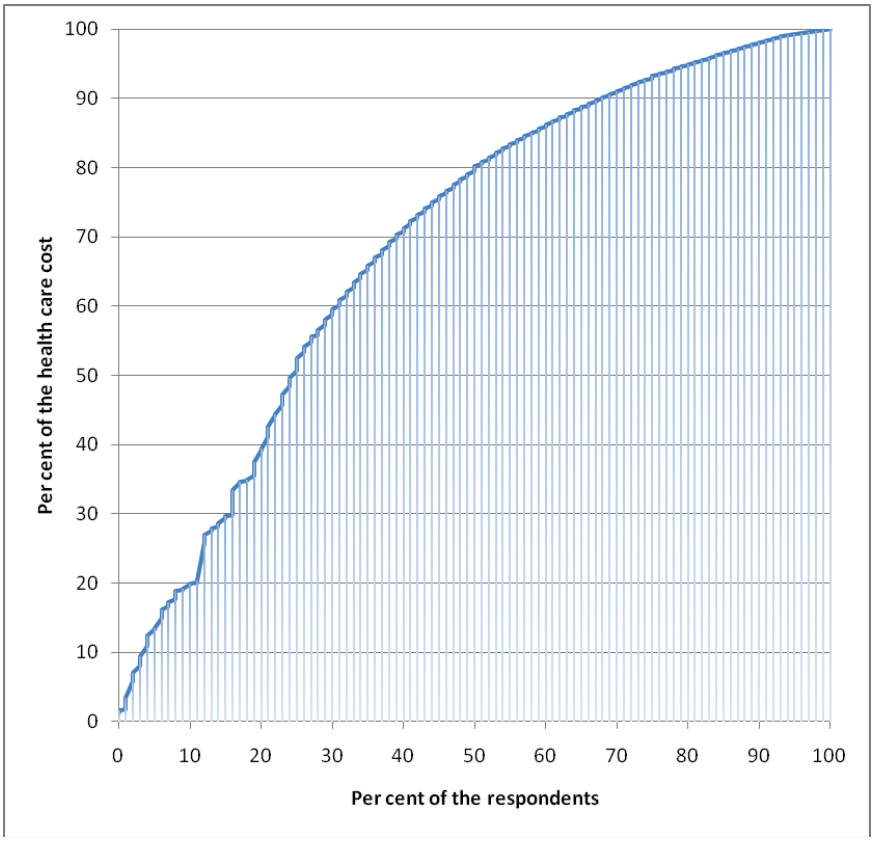

Figure 2 Distribution of total healthcare costs.

rehabilitation for patients with neck and shoulder pain. In the present study, physiotherapy treatments accounted for 60% of the healthcare costs and two thirds of the patients consulted a PT 3-4 times on average.

Whether an intervention programme is cost-effective or not depends on the relevance of the clinical outcomes and the costs needed to achieve this [41-43].

In the present study, 89% were diagnosed with subacromial or nonspecific shoulder pain. Feleus et al [44] found that 41% of the patients with non-traumatic neck, arm, or shoulder pain were given an unspecific diagnostic code at the first consultation in primary health care, and no differences were found in severity, complaints or functional limitations compared to patients with a specific diagnostic code. A specific diagnosis was given in 59% of the cases, mostly subacromial impingement syndrome. Distinction between diagnostic groups is important if these groups have different prognoses or require different management. Patients with specific diagnoses were more frequently referred for specialist treatment, while patients with non-specific diagnoses were more frequently referred for physiotherapy in the Dutch study [44]. Non-specific shoulder pain - the presence of pain without specific physical signs and pathology - is common, and Miranda et al [45] found that subjective complaints without clinical findings may indicate adverse psychological and psychosocial factors rather than an underlying pathologic condition. Several studies have reported that long-term sickness absence was associated with work conditions rather than with individual characteristics [46].

Future studies should include cost-effectiveness evaluation of various physiotherapy regimens or comparisons of physiotherapy with other treatments for shoulder pain. Functional limitations and duration of sick leave should be included as outcome measures. Such studies will be

Table 6 Uncertainty

Changed parameter or method	Percentage change in parameter	Percentage change in total cost	Percentage change in HC cost	Total cost (95% confidence interval)	Healthcare cost (95% confidence interval)
Base case scenario	0.0	0.0	0.0	2069 (1283-2856)	326 (273-380)
Parameters, one-way sensit. analysis					
PT cost per consultation	+30	2.8	18.0	2128 (1339-2917)	385 (317-453)
	-30	-2.8	-18.0	2011 (1227-2795)	268 (228-307)
GP cost per consultation	+50	2.3	14.6	2117 (1328-2906)	374 (318-430)
	-50	-2.3	-14.6	2022 (1238-2805)	279 (227-330)
Sick leave cost per day	+30	25.3	0.0	2592 (1575-3610)	326 (273-380)
	-30	-25.3	0.0	1546 (991-2102)	326 (273-380)
X-ray cost per consultation	+30	0.3	1.7	2075 (1288-2861)	332 (278-385)
	-30	-0.3	-1.7	2064 (1278-2850)	321 (268-374)
Ultrasound cost per consultation	+30	0.2	1.3	2074 (1287-2860)	330 (277-384)
	-30	-0.2	-1.3	2065 (1279-2851)	322 (269-375)
Medicine, unit used	+100	0.2	1.1	2073 (1286-2859)	330 (276-383)
	-50	-0.1	-0.5	2068 (1281-2854)	324 (271-378)
Parameters, multi-way sensit. analysis					
PT, GP per consultation	+30. +50	5.1	32.6	2176 (1384-2967)	432 (364-502)
	-30. -50	-5.1	-32.6	1963 (1182-2744)	220 (183-257)
PT, GP, x-ray, ultras. per consultation	As for one- way sensit. a.	5.7	35.8	2186 (1394-2979)	443 (373-513)
		-5.7	-35.8	1952 (1172-2733)	209 (173-246)
Method, one-way sensitivity analysis					
Sick leave cost based on friction method	-61.3	-51.6	0.0	1001 (685-1316)	326 (273-380)

Calculation of percentage change and new levels of total costs and health service costs by changing the unit costs of the different cost components

extensive and time-consuming, but study protocols have been presented [47,48].

Strengths and limitations of the study

A limitation of the present study is that we do not know whether the patients were relieved from their symptoms when the treatment period was ended, or if they disappeared out of the system for other reasons. The costs were limited to the primary diagnoses for the visit, and ignored costs associated with comorbidity. This is often the case in cost-of-illness studies and a simplification of real life, as has been pointed out by Koopmanschap [49]. When we looked closer into the three cases with sick leave more than six months, we found that they all had additional diagnoses. We could not gather such information for the rest of the group with the method applied.

We had information about sick leave periods prescribed by GP, but we do not know if patients were actually absent from work all that time. We had no information about short-term sick leave, nor whether patients had sick leave prescribed by orthopaedic surgeon post-operatively. To fully estimate the cost for productivity loss additional data would have been required, for instance self-reported data from cost diaries or logbooks [15,42], or questionnaires [32]. However, a recent study suggests that self-reported data are less valid than register-based data to measure the number of days on sick leave [50].

Table 7 Multivariable linear regression analysis

Independent variables	Log (total cost)	Log (health service cost)
Place of treatment	-0,043	-0,119
	(0,118)	(0,224)
Gender	0,160	0,202
	(0,117)	(0,222)
Age	0,003	-0,002
	(0,005)	(0,010)
Constant	5,207	6,007
	(0,275)	(0,523)
Observations	203	203

The numbers in parentheses below the estimates are the standard errors

The cost for medication is probably underestimated in this study. We had no information on the consumption of drugs, nor of the medication paid out of pocket. However, medication had a minor contribution to the total cost, and we do not expect that costs for medication would have an important impact on the results.

Generalization to other settings might be difficult, and will depend on how diagnostic codes are used, how reliable the registration is, and how costs are determined. The reliability of the cost estimates and varying research methodology have been under debate [51]. Charges for hospital services, like radiographic imaging, do not always reflect the actual unit cost of a production, but is merely a vehicle for transferring money between healthcare service units. However, these costs are easily available and most often the only costs available and therefore used in the present study. The measurement of productivity loss due to illness is highly dependent of the choice of approach, and this calls for standardisation on a national level. In the Netherlands a "Standardisation of costs; a manual for costing in economic evaluations" [52] was issued to eliminate some of the price differences between studies and to give guidelines for a uniform costing methodology.

The strength of the present study is that we were able to capture almost all patients consulting with all types of shoulder pain during a six-month period. There were few alternatives to medical care and data were manually controlled. We can double the total cost to illustrate the annual cost to society and to the health care system for shoulder pain in the chosen area. Our study provides direct and meaningful information about the size of the problem and can be an essential component in further cost-effectiveness analyses of different treatment strategies in primary health care.

Conclusions

Costs for sick leave for shoulder pain contributed to more than 80% of the total costs for society for this patient category. These results are in line with other studies on neck, shoulder and back pain. Health care interventions should focus on getting people back into the workforce, with special attention towards the small group that generates the highest costs. The model applied in the current study may be applied in future studies to analyse changes over time in terms of illness patterns in medical and health economic perspectives. A societal perspective is needed for the inclusion of all consequences of the interventions.

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Authors' contributions

LV, PJ and RE designed the study. LV collected the data. All authors participated in the study, and drafted the manuscript. PJ performed the statistical analysis. All authors read, critically revised, and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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