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Original article

Less than half of patients in secondary care adheres to clinical guidelines for subacromial pain syndrome and have acceptable symptoms after treatment: A Danish nationwide cohort study of 3306 patients

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ABSTRACT

Background: Evidence-based guidelines recommend exercise-therapy as first line treatment for subacromial pain syndrome, but no previous study has mapped the content of care for subacromial pain syndrome and knowledge about adherence to clinical guidelines are lacking. We aim to describe the content and outcome of current care and investigate the relationship between content and outcome of care.

Methods: We invited all patients diagnosed with subacromial pain syndrome at any Danish hospital to participate in this nationwide retrospective population-based cohort-study. Patient-reported information on content of care was collected using a validated questionnaire. Outcome of care was assessed using global impression of change (GIC) and patient acceptable symptom state (PASS). Invitations were sent 14 weeks after diagnosis.

Results: In total, 3306 eligible patients participated. At follow-up, 45% had completed the recommended 12 weeks of exercise-therapy. From the total cohort, 12% underwent surgery without completing 12 weeks of exercise-therapy. For patients undergoing non-operative care, 43% reached PASS while 61% were improved since diagnosis at the hospital. Completing 12 weeks with exercise-therapy did not increase the odds of improvement (OR 1.05, 95%CI:0.88–1.24), but having conducted strengthening exercises did (OR 1.65, 95% CI:1.25–2.19).

Conclusion: More than half of patients diagnosed with subacromial pain syndrome in specialist care settings do not adhere to recommendations regarding duration of exercise-therapy, but this is not related to symptom improvement. Conversely, conducting strengthening exercises relates to higher chance of symptom improvement. This challenges current clinical guidelines, indicating that a time-based cut-point may not be relevant while specific types of exercises are.

1. Introduction

The most common cause of shoulder pain is subacromial pain syndrome, also known as subacromial impingement, which is responsible for 45–80% of shoulder related contacts to general practitioners (Östör et al., 2005; van der Windt et al., 1995). Subacromial pain syndrome is associated with low health-related quality of life (MacDermid et al., 2004) and is often persistent (van der Windt et al., 1996), why many patients are referred to orthopaedic specialist care. Evidence-based guidelines recommend non-operative care, including exercise therapy (Exercise therapy - MeSH, 2019), as first line treatment for subacromial pain syndrome (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Diercks et al., 2014; Pedowitz et al., 2011; Hopman et al., 2013). and surgery should only be considered when non-operative care fails (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Hopman et al., 2013). The recommended duration of exercise-based non-operative care, before surgery is considered, is not clearly stated in all guidelines, but a total of approximately 12 weeks is mentioned in some (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014). This fits well

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with the duration of the exercise-based interventions examined in randomized controlled trials (Holmgren et al., 2012; Bennell et al., 2010; Kromer et al., 2013). According to clinical guidelines, exercise therapy includes various types of exercises, such as mobility, stretching, strengthening, posture correction and exercise for control of the scapula (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Hopman et al., 2013; Sundhedsstyrelsen, 2013). Furthermore, non-operative care may also include various types of supplementary care, such as corticosteroid injections, laser therapy, acupuncture, massage, mobilization techniques, taping etc. (Bury and Littlewood, 2018), though most of these are rarely mentioned in clinical guidelines (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Hopman et al., 2013; Sundhedsstyrelsen, 2013). Collectively, the wide array of treatment options leaves practitioners and patients with many options when planning non-operative care, some better supported by current evidence than others. The clinical guidelines are meant to assist practitioners and patients in such decisions (Institute of Medicine (US) Committee to Advise the Public Health Service on Clinical Practice GuidelinesField and Lohr, 1990). However, there seems to be great variation in the uptake and adherence of such guidelines (Mafi et al., 2013; Cabana et al., 1999), which might result in more frequent use of inappropriate treatments and lack of application of effective care for these patients. Currently, knowledge about the content of non-operative care for subacromial pain syndrome is limited to survey responses from physiotherapy practitioners (Bury and Littlewood, 2018; Pieters et al., 2019). While these responses indicate that most physiotherapists would recommend different variations of exercise therapy for a patient with symptoms consistent with subacromial pain syndrome (Bury and Littlewood, 2018; Pieters et al., 2019), these data do not necessarily reflect everyday clinical actions, and does not provide knowledge about adherence to clinical guidelines in everyday clinical practice. In addition, the abovementioned surveys (Bury and Littlewood, 2018; Pieters et al., 2019) illustrate great variation in clinical decision-making when physiotherapists are choosing among the various types of exercises; maybe because clinical guidelines do not recommend specific types of exercises over others, as there is no evidence to support such recommendations.

1.1. Aim

First, we aim to map the content of current care for subacromial pain syndrome in relation to evidence-based clinical guidelines, using a validated patient-reported questionnaire. Secondly, we describe the outcome of non-operative care and investigate the relationship between content and outcome of care, focusing on the importance of clinical guideline adherences and types of exercises, to inform clinical decision-making and future research within this field.

2. Methods

2.1. Procedures

This is a retrospective population-based cohort study with patient-reported data on content and outcome of non-operative care. We invited all Danish citizens diagnosed with subacromial pain syndrome in a private or public outpatient hospital clinic during the period from November 1, 2018 to February 11, 2019, who had no recorded contacts for a similar diagnosis within the last year. Patients eligible for inclusion were identified through the National Patient Registry in Denmark using the diagnostic codes DM75.1 and DM75.4.

We invited patients through 'e-Boks'; a secured email system used by public and private organizations to contact Danish citizens. It is mandatory to receive all letters from public institutions through this system, and exception from this requires a dispensation. Personalized invitation letters containing a unique link to the questionnaire were sent to all eligible patients 14 weeks after the date of diagnosis. Up to four weekly reminders were sent to patients if the questionnaire was not answered.

When opening the questionnaire, patients were given the option to state if they had not recently undergone a medical shoulder examination (within approximately 3–4 months), and hence were not eligible for inclusion. Before answering any further questions, patients were asked to enter their telephone number, allowing us to contact them if needed. The online questionnaire included questions regarding demographics and socio-economy, disease-specific characteristics, content of care, and outcome of care. All data were collected through RedCap® using discrete answer options and range checks as appropriate. According to the Danish Act on Research Ethics Review of Health Research Projects, the Ethics Committee for the Capital Region of Denmark deemed the study to be exempt from ethical review (Journal Number: H-17007270) due to the study design. This study was conducted in accordance with the Helsinki Declaration (World Medical Association, 2012) and was approved by the Danish Data Protection Agency.

2.2. Content of non-operative care

The questionnaire regarding content of non-operative care was developed specifically for this study. First, we developed an initial version based on the treatment modalities mentioned in clinical guidelines for treatment of subacromial pain syndrome (Danish Health Authority, 2016; Sundhedsstyrelsen, 2013) and referral guidelines (Sundhedsstyrelsen, 2011), supplemented with other common physiotherapy treatment elements not mentioned herein. All questions were formulated to facilitate that patients would understand the intended meaning of questions (i.e. the statement "I have conducted exercises to strengthen the shoulder muscles, for example using elastic bands or weights" was used to cover if patients had conducted strengthening exercises. Afterwards, we invited all members of the working group involved in the development of the Danish National Clinical Guidelines (Danish Health Authority, 2016; Sundhedsstyrelsen, 2013) to comment on the questionnaire, either at a meeting dedicated specifically to this or via email. Ten members provided comments, and we developed a revised version based on systematic condensation of all comments. Finally, we revised and validated all questions using the *Three-Step Test Interview* method described by Hak et al. (2008); a method found suitable for testing and development of questionnaires (Pool et al., 2010; Paap et al., 2016), by observation of the interaction between the instrument and respondents (Hak et al., 2008). For this process, we recruited nine patients with subacromial pain syndrome from a local public rehabilitation facility, who 1) had undergone non-operative care for two months or more, 2) had actively engaged with rehabilitation within the last two weeks, and 3) had not undergone surgery for their current shoulder disorder. We aimed at recruiting a sample representing a wide range of educational backgrounds and age groups. The *Three-Step Test Interview* (Hak et al., 2008) consists of three phases: step 1) respondents complete the questionnaire while thinking out loud while the interviewer takes notes; step 2) respondents are interviewed based on the notes from step 1; and step 3) the respondents are given the chance to explain any ponderings and reflections in relation to the questionnaire. Furthermore, in cases where doubts arose about a patient's understanding of exercise types, they were asked to simulate the exercise in the interview room. Collectively, this allows for the interviewing physiotherapist to note, interpret and further interview the respondent when their understanding does not fit the intended meaning of a question. Data from all interviews were condensed and analyzed using the 4-step systematic approach described by Collins (2015), followed by qualitative peer examination of the results to increase their reflexivity and internal validity (Merriam, 1988). We identified four general areas of concern in relation to the questionnaire; chronology and wording of questions, and distinction and understanding of concepts. To accommodate to these concerns, we re-arranged the relevant questions and added explanatory text where needed. For a detailed description and

results of the qualitative validation, see supplemental file 1. The final version included the following categories of questions: Healthcare consultations; amount, types, instructions and adjustments of exercise therapy; and types of supplemental care.

2.3. Outcome of care

Patient-reported shoulder disability was quantified using the Shoulder Pain and Disability Index (SPADI) score, which range from 0 (best) to 100 (worst) and is calculated separately for the five-item pain sub-scale and the eight-item function sub-scale (Roach et al., 1991). As suggested by Christensen et al. (2018), we adjusted SPADI-pain scores for differential item function by age and omitted items 8 and 12 from the SPADI-function sub-scale. Patient Acceptable Symptom State (PASS) was measured as the dichotomous answer (yes/no) to a standardized question regarding the acceptability of the current state of the shoulder symptoms. Global Impression of Change (GIC) was measured on a 7-point Likert scale ranging from 'Much better, a very important improvement' to 'Much worse, an important aggravation'. Job-related disability was quantified using the work module of Quick Disability of the Arm, Shoulder, and Hand questionnaire (QDASH-work). Q-DASH is upper extremity specific and the work module consists of four items regarding the impact of the problem on the ability to work. All questions are score from 1 to 5, responses are summed and normalized to a total score ranging from 0 (best) to 100 (worst) (Beaton et al., 2005).

2.4. Statistics

Descriptive statistics with means and standard deviations (SD) or median and interquartile range [IQR] were applied for continuous variables. For categorial variables, proportion were calculated by dividing the number patients providing a specific response by the total number of responses to that question. Corresponding 95% CIs were computed using a normal approximation to the binomial CIs. All data are presented for the full cohort, and separately for those having undergone non-operative care and surgery, respectively. The impact of having engaged with exercise therapy (yes/no), having completed 12 weeks with exercise therapy as recommended in the Danish National Clinical Guidelines (Danish Health Authority, 2016; Sundhedsstyrelsen, 2013) (yes/no), and each of the four types of exercise therapy (mobility, posture correction including scapula setting, strength and stretching, yes/no) on the outcome of non-operative care was investigated using logistic regression models. A dichotomized version of GIC (slightly better, better, or much better vs unchanged or worse) was used as the dependent variable. Separate analyses were conducted for each of the independent variables, both unadjusted and adjusted for the following possible confounders: age, gender, symptom duration, dominant side affected, education level, and compensation claim (Engebretsen et al., 2010; Kennedy et al., 2006). Secondly, a fully adjusted analysis, including all independent variables, were conducted. Only patients who had not underwent surgery at the time of questionnaire completion were included in these regression analyses. All analyses were conducted using up to date versions of IBM SPSS statistics and Microsoft Excel. A significance level of 0.05% was applied.

2.5. Sample size considerations

The sample size estimation was based on the margin of error for proportions of responses. Based on data from the National Patient Registry, we estimated that 15 000 Danish citizens per year would fulfill the eligibility criteria, corresponding to 3–4000 during the inclusion period. Assuming a total population size of 15 000 patients, responses from 1000 patients and a 95% confidence level would yield an error margin of 3%, while the error margin would be 1.6% with responses from 3000 patients.

3. Results

3.1. Participants and study flow

A total of 4521 eligible patients were identified through the Danish National Patient Registry and hence invited to participate in this study through 'e-Boks'. From these, 3373 (75%) replied to the invitation, but 67 patients reported they had not undergone shoulder examination within the last 3–4 months, and were hence excluded, leaving 3306 to be included in this study. For further details on study flow, see Fig. 1.

Median time between diagnosis at the hospital clinic and completion of the questionnaire was 16.7 weeks [IQR 15.4; 18.0]. Median symptom duration was 12 months [IQR 7; 24], 51% were females, mean age 57 years (SD 14). A gradual onset of symptoms was reported by 63% of the patients. The majority of patients (76%) reported to work with their hands above shoulder height approximately one fourth of the time or less, and 47% considered work as the main cause of problem. A total of 21% were part- or full time absent from work, unemployed, or early retired due to their shoulder disorder. For further details, see Table 1.

3.2. Content of care

Data on content of care is presented in Table 2. From all included patients, 45% reported to have completed 12 weeks of exercise therapy. More than half of the remaining patients were still engaged with exercise therapy (29% of all), but one-fourth had either stopped before reaching 12 weeks (13% of all) or had not engaged with exercise therapy at all (13% of all). From the full cohort, 21% (n = 683) had underwent surgery for their shoulder condition at four months follow-up, with 40% (n = 265) of these reporting to have engaged with exercise therapy for 12 or more weeks as part of the treatment for their current shoulder disorder. Median number of healthcare consultations amounted to 2 [IQR 1; 4] at

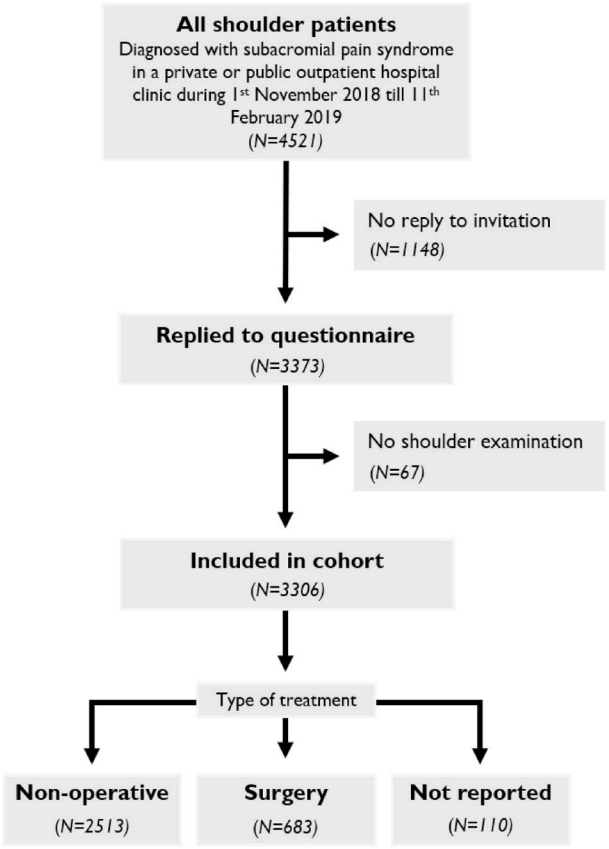

Fig. 1. Flowchart.

Table 1
Disease characteristics, socio-demographics, and occupational factors for the full cohort and separately for patients undergoing non-operative care and surgery, respectively, presented as medians [IQR] and proportions (95%CI).

	Full Cohort			Non-operative care			Surgery		
			N =			*N* =			*N* =
Symptom duration (months)	12	[7; 24]	*3183*	12	[7; 24]	*2501*	16	[10; 30]	*682*
Gender (% females)	51%	(49%–53%)	*1636 of 3196*	52%	(50%–54%)	*1314 of 2513*	49%	(45%–52%)	*332 of 683*
Age (years)	56	[49; 65]	*3196*	56	[49; 65]	*2513*	57	[51; 64]	*683*
Dominant side affected (% yes)	57%	(55%–59%)	*1828 of 3196*	57%	(55%–59%)	*1427 of 2514*	59%	(55%–62%)	*401 of 682*
Gradual onset (% yes)	63%	(61%–64%)	*2003 of 3196*	62%	(60%–64%)	*1561 of 2513*	65%	(61%–68%)	*442 of 683*
Time between diagnosis and follow-up (weeks)	17	[15; 18]	*3195*	17	[15; 18]	*2512*	17	[15; 18]	*683*
Cause of problem (%)									
Work	47%	(45%–48%)	*1412 of 3027*	46%	(44%–48%)	*1090 of 2377*	50%	(46%–53%)	*322 of 650*
Sport/exercise	12%	(11%–14%)	*375 of 3027*	13%	(12%–14%)	*312 of 2377*	10%	(7%–12%)	*63 of 650*
Other	41%	(39%–43%)	*1240 of 3027*	41%	(39%–43%)	*975 of 2377*	41%	(37%–44%)	*265 of 650*
Job status (%)									
Retired	25%	(24%–27%)	*808 of 3197*	25%	(24%–27%)	*637 of 2514*	25%	(22%–28%)	*171 of 683*
Full time	44%	(42%–45%)	*1399 of 3197*	46%	(44%–48%)	*1152 of 2514*	36%	(32%–40%)	*247 of 683*
Part time	2%	(1%–2%)	*63 of 3197*	2%	(1%–2%)	*44 of 2514*	3%	(1%–4%)	*19 of 683*
Part time due to shoulder	9%	(8%–10%)	*275 of 3197*	10%	(8%–11%)	*241 of 2514*	5%	(3%–7%)	*34 of 683*
Sick leave	5%	(4%–5%)	*152 of 3197*	3%	(2%–3%)	*64 of 2514*	13%	(10%–15%)	*88 of 683*
Sick leave due to shoulder	2%	(2%–3%)	*70 of 3197*	2%	(1%–2%)	*48 of 2514*	3%	(2%–4%)	*22 of 683*
Unemployed	3%	(2%–4%)	*98 of 3197*	3%	(2%–3%)	*70 of 2514*	4%	(3%–6%)	*28 of 683*
Unemployed due to shoulder	5%	(4%–5%)	*152 of 3197*	5%	(4%–6%)	*120 of 2514*	5%	(3%–6%)	*32 of 683*
Early retirement	0%	(0%–0%)	*8 of 3197*	0%	(0%–0%)	*6 of 2514*	0%	(0%–1%)	*2 of 683*
Early retirement due to shoulder	5%	(4%–5%)	*146 of 3197*	4%	(4%–5%)	*110 of 2514*	5%	(4%–7%)	*36 of 683*
Physical activity in primary occupation (%)									
Mainly sedentary	36%	(35%–38%)	*1103 of 3028*	37%	(35%–39%)	*882 of 2376*	34%	(30%–37%)	*221 of 652*
Mainly standing, not physically demanding	17%	(16%–18%)	*513 of 3028*	18%	(17%–20%)	*430 of 2376*	13%	(10%–15%)	*83 of 652*
Standing or walking, some carrying	33%	(32%–35%)	*1010 of 3028*	32%	(31%–34%)	*770 of 2376*	37%	(33%–40%)	*240 of 652*
Heavy or fast, physically demanding	13%	(12%–14%)	*402 of 3028*	12%	(11%–14%)	*294 of 2376*	17%	(14%–19%)	*108 of 652*
Work with arms over shoulder (%)									
Almost all the time	5%	(5%–6%)	*164 of 3028*	5%	(4%–6%)	*125 of 2376*	6%	(4%–8%)	*39 of 652*
¾ of the time	5%	(4%–6%)	*158 of 3028*	5%	(4%–5%)	*111 of 2376*	7%	(5%–9%)	*47 of 652*
½ of the time	13%	(12%–14%)	*399 of 3028*	13%	(11%–14%)	*297 of 2376*	16%	(13%–18%)	*102 of 652*
¼ of the time	23%	(21%–24%)	*683 of 3028*	23%	(21%–24%)	*538 of 2376*	22%	(19%–25%)	*145 of 652*
Rarely	42%	(40%–44%)	*1276 of 3028*	42%	(40%–44%)	*1006 of 2376*	41%	(38%–45%)	*270 of 652*
Never	11%	(10%–13%)	*348 of 3028*	13%	(11%–14%)	*299 of 2376*	8%	(5%–9%)	*49 of 652*
Education level (%)									
Elementary or less	19%	(17%–20%)	*597 of 3172*	18%	(17%–20%)	*461 of 2493*	20%	(17%–23%)	*136 of 679*
High school	5%	(4%–5%)	*150 of 3172*	5%	(4%–6%)	*126 of 2493*	4%	(2%–5%)	*24 of 679*
Vocational education	36%	(35%–38%)	*1152 of 3172*	36%	(34%–38%)	*890 of 2493*	39%	(35%–42%)	*262 of 679*
Higher education, short to medium	33%	(31%–34%)	*1039 of 3172*	33%	(31%–35%)	*821 of 2493*	32%	(29%–36%)	*218 of 679*
Long higher education or more	7%	(6%–8%)	*234 of 3172*	8%	(7%–9%)	*195 of 2493*	6%	(4%–7%)	*39 of 679*
Compensation claim (%)									
Applied, confirmed	4%	(3%–4%)	*111 of 3170*	3%	(3%–4%)	*87 of 2491*	4%	(2%–5%)	*24 of 679*
Applied, awaiting	9%	(8%–10%)	*295 of 3170*	7%	(6%–8%)	*176 of 2491*	18%	(15%–20%)	*119 of 679*
Applied, rejected	4%	(3%–4%)	*121 of 3170*	4%	(3%–4%)	*90 of 2491*	5%	(3%–6%)	*31 of 679*
Have not applied	83%	(82%–85%)	*2643 of 3170*	86%	(84%–87%)	*2138 of 2491*	74%	(71%–78%)	*505 of 679*

general practitioner, 2 [IQR 1; 3] at medical specialist, and 6 [IQR 2; 12] at physiotherapist, with slightly higher numbers for patients who had undergone surgery at the time of follow-up (see Table 2). Most patients declared that exercises had constituted the most significant part of the overall care (59%), while the categories 'passive modalities' (10%) and 'other' (31%) were less commonly used.

3.2.1. *Types and setting of exercise therapy*

For patients who had engaged with exercise therapy, the most used types of exercise were mobility (93%) and strengthening (87%) followed by stretching (77%) and posture correction including scapula setting (57%). Most patients reported that either strengthening (41%) or mobility exercises (41%) constituted the most significant part of exercises therapy. A large proportion of the patients had conducted exercises at home (94%) and/or at individual treatment sessions (73%), while group-based settings were less common (16%).

3.2.2. *Supplementary care*

Massage was the most commonly reported type of supplementary care (46%), followed by ultrasound therapy (31%), mobilization (30%), ergonomic advice (29%), and taping (27%). Acupuncture and laser therapy were reported by 18% and 12%, respectively. Two out of every three patients (68%) had one or more steroid injections for their current shoulder disorder, median 1 [IQR 0; 2]. For patients who had undergone surgery, this was only the case for 56%, median 1 [IQR 0; 2].

3.3. *Clinical outcome of non-operative care*

From the patients who had underwent non-operative care only, 43% (n = 1026 of 2404) had reached an acceptable symptom state at four-month follow-up, while 61% reported to be at least slightly better compared to the time of diagnosis at the hospital. Their median SPADI pain and disability score was 56 [IQR 32; 76] and 33 [IQR 12; 58], respectively. Median QDASH work score was 31 [IQR 8; 63]. For further details, see Table 3.

Table 2
Content of care for the full cohort and separately for patients undergoing non-operative care and surgery, respectively, presented as medians [IQR] and proportions (95%CI).

	Full Cohort			Non-operative care			Surgery		
Healthcare consultations			*N =*			*N =*			*N =*
General practitioner	2	[1; 4]	*3137*	2	[1; 3]	*2468*	3	[1; 4]	*669*
Medical specialist at hospital	2	[1; 3]	*3137*	2	[1; 3]	*2466*	3	[2; 4]	*671*
Physiotherapist	6	[2; 12]	*3140*	6	[2; 12]	*2470*	8	[3; 14]	*670*
Chiropractor	0	[0; 0]	*3135*	0	[0; 0]	*2466*	0	[0; 0]	*669*
Have done exercises	87%	(86%–88%)	*2723 of 3120*	85%	(84%–86%)	*2085 of 2453*	96%	(94%–97%)	*638 of 667*
Setting									
Individual treatment	73%	(71%–74%)	*1976 of 2721*	70%	(68%–72%)	*1468 of 2083*	80%	(76%–83%)	*508 of 638*
Group-based	16%	(15%–18%)	*446 of 2719*	14%	(12%–15%)	*286 of 2082*	25%	(22%–28%)	*160 of 637*
Home-based w/instruction	94%	(93%–94%)	*2544 of 2720*	93%	(92%–94%)	*1931 of 2083*	96%	(95%–98%)	*613 of 637*
Other	20%	(18%–21%)	*540 of 2719*	21%	(19%–23%)	*440 of 2083*	16%	(13%–18%)	*100 of 636*
Types									
Mobility	93%	(92%–94%)	*2520 of 2713*	91%	(90%–93%)	*1898 of 2078*	98%	(97%–99%)	*622 of 635*
Posture	57%	(55%–58%)	*1536 of 2713*	56%	(54%–58%)	*1170 of 2078*	58%	(54%–61%)	*366 of 635*
Strength	87%	(85%–88%)	*2351 of 2713*	88%	(86%–89%)	*1819 of 2078*	84%	(81%–87%)	*532 of 635*
Stretching	77%	(75%–78%)	*2081 of 2713*	74%	(73%–76%)	*1547 of 2078*	84%	(81%–87%)	*534 of 635*
Other	18%	(17%–20%)	*499 of 2713*	18%	(17%–20%)	*382 of 2078*	18%	(15%–21%)	*117 of 635*
Weeks with exercise									
0 weeks	13%	(12%–14%)	*405 of 3083*	16%	(14%–17%)	*376 of 2424*	4%	(3%–6%)	*29 of 659*
1–6 weeks	19%	(18%–20%)	*586 of 3083*	17%	(15%–18%)	*409 of 2424*	27%	(23%–30%)	*177 of 659*
7–11 weeks	23%	(22%–25%)	*711 of 3083*	22%	(20%–23%)	*523 of 2424*	29%	(25%–32%)	*188 of 659*
12–26 weeks	33%	(32%–35%)	*1031 of 3083*	34%	(32%–36%)	*820 of 2424*	32%	(28%–36%)	*211 of 659*
More than 26 weeks	11%	(10%–12%)	*350 of 3083*	12%	(11%–13%)	*296 of 2424*	8%	(6%–10%)	*54 of 659*
Still engaged with exercise therapy	68%	(66%–69%)	*2116 of 3120*	64%	(62%–66%)	*1565 of 2453*	83%	(80%–85%)	*551 of 667*
Supplementary care									
Ultrasound therapy	31%	(29%–32%)	*944 of 3071*	32%	(30%–34%)	*778 of 2415*	25%	(22%–29%)	*166 of 656*
Laser	12%	(11%–13%)	*371 of 3070*	13%	(11%–14%)	*305 of 2414*	10%	(8%–12%)	*66 of 656*
Shockwave	6%	(5%–7%)	*193 of 3070*	6%	(5%–7%)	*154 of 2414*	6%	(4%–8%)	*39 of 656*
Heat/cold	13%	(12%–14%)	*397 of 3071*	12%	(11%–14%)	*296 of 2415*	15%	(13%–18%)	*101 of 656*
Tape	27%	(26%–29%)	*834 of 3071*	27%	(25%–29%)	*647 of 2415*	29%	(25%–32%)	*187 of 656*
Ergonomic advice	29%	(27%–30%)	*885 of 3071*	29%	(27%–31%)	*701 of 2415*	28%	(25%–31%)	*184 of 656*
Massage	46%	(44%–47%)	*1401 of 3073*	47%	(45%–49%)	*1129 of 2415*	41%	(37%–45%)	*272 of 658*
Manipulation	9%	(8%–10%)	*262 of 3071*	10%	(9%–11%)	*238 of 2415*	4%	(2%–5%)	*24 of 656*
Mobilization techniques	30%	(28%–31%)	*909 of 3070*	29%	(27%–31%)	*702 of 2414*	32%	(28%–35%)	*207 of 656*
TENS etc.	4%	(3%–5%)	*121 of 3071*	4%	(3%–4%)	*90 of 2415*	5%	(3%–6%)	*31 of 656*
Acupuncture	18%	(17%–19%)	*552 of 3070*	19%	(17%–20%)	*456 of 2415*	15%	(12%–17%)	*96 of 655*
Pain medication	70%	(68%–72%)	*2153 of 3072*	65%	(63%–66%)	*1559 of 2415*	90%	(88%–93%)	*594 of 657*
Sling	21%	(20%–23%)	*649 of 3070*	8%	(7%–10%)	*204 of 2414*	68%	(64%–71%)	*445 of 656*
Steroid injection	1	[0; 2]	*3072*	1	[0; 2]	*2415*	1	[0; 2]	*657*

Table 3
Outcome of care for the full cohort and separately for patients undergoing non-operative care and surgery, respectively, presented as medians [IQR] and proportions (95%CI).

	Full Cohort			Non-operative care			Surgery		
Patient acceptable symptom state	42%	(40%–43%)	*1270 of 3059*	43%	(41%–45%)	*1026 of 2404*	37%	(33%–41%)	*244 of 655*
Global impression of change									
Much improved or cured	21%	(19%–22%)	*629 of 3059*	20%	(18%–21%)	*470 of 2404*	24%	(21%–27%)	*159 of 655*
Improved	18%	(16%–19%)	*538 of 3059*	16%	(15%–18%)	*395 of 2404*	22%	(19%–25%)	*143 of 655*
Small improvement	25%	(24%–27%)	*776 of 3059*	25%	(23%–27%)	*605 of 2404*	26%	(23%–29%)	*171 of 655*
Same	23%	(22%–25%)	*705 of 3059*	26%	(24%–28%)	*625 of 2404*	12%	(10%–15%)	*80 of 655*
Little worse	6%	(5%–7%)	*177 of 3059*	5%	(4%–6%)	*128 of 2404*	7%	(5%–9%)	*49 of 655*
Worse	4%	(4%–5%)	*133 of 3059*	4%	(3%–5%)	*103 of 2404*	5%	(3%–6%)	*30 of 655*
Much worse	3%	(3%–4%)	*101 of 3059*	3%	(3%–4%)	*78 of 2404*	4%	(2%–5%)	*23 of 655*
			N =			*N =*			*N =*
SPADI pain	56	[32; 76]	*2996*	56	[32; 76]	*2351*	60	[32; 76]	*642*
SPADI disability	35	[12; 60]	*2997*	33	[12; 58]	*2352*	40	[15; 65]	*642*
QDASH work	31	[13; 63]	*3024*	31	[8; 63]	*2372*	44	[25; 75]	*649*

3.4. Impact of non-operative care content

Patients reporting to have engaged with exercise therapy as part of non-operative care had significantly higher odds of improvement (reporting at least 'slightly better') compared to the time of diagnosis at the hospital in both univariate (OR 1.48 95%CI 1.18 to 1.86) and confounder adjusted analyses (OR 1.66 95%CI 1.32 to 2.10). Conversely, having completed 12 weeks of exercise was not related to

the odds of improvement (OR 1.05 95%CI 0.88 to 1.24). In unadjusted analyses, both mobility and strengthening exercises were related to higher odds of improvement (OR 1.40 and 1.51, respectively, $p < 0.01$), while postural exercises were related to significantly lower odds of improvement (0.85 95%CI 0.72 to 1.00, $p = 0.045$). In the fully adjusted model, only strengthening exercises remained to have a positive impact on the odds of improvement (OR 1.65 95%CI 1.25 to 2.19), while having engaged with postural exercises was related to significantly lower odds of improvement (OR 0.77 95%CI 0.63 to 0.94). Not surprisingly, the overall impact of having engaged with exercise therapy was diminished when including the specific exercise types in the full model. See Table 4 and Fig. 2 for further details.

4. Discussion

In this nationwide retrospective cohort study of 3306 patients with subacromial pain syndrome, more than half of patients had not completed the recommended minimum of 12 weeks with exercise therapy 4 months after diagnosis at the hospital, while less than half had reached an acceptable symptom state at that time. However, having completed 12 weeks with exercise therapy did not increase the odds of improvement, but having conducted strengthening exercises did.

4.1. Adherence to exercise recommendations and outcome of non-operative care

This study is the first to map the current care for subacromial pain syndrome in relation to evidence-based clinical guidelines and shows that the majority of patients diagnosed with subacromial pain syndrome in a specialist care setting engages with exercise therapy (87%). This fits well with evidence-based guidelines, as exercise therapy is considered key in current care for subacromial pain syndrome (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Diercks et al., 2014; Pedowitz et al., 2011; Hopman et al., 2013; Sundhedsstyrelsen, 2013) and aligns well with prior studies showing that most physiotherapists consider exercise therapy a part of the treatment plan (Bury and Littlewood, 2018; Pieters et al., 2019). Adherence to recommendations regarding duration of exercise therapy was less impressive, as one-fourth of all patients had either stopped before reaching 12 weeks (13%) or had not engaged with exercise therapy at all (13%), while 40% of the patients who underwent surgery had not completed 12 weeks with exercise therapy. The latter is in striking contrast to the national clinical guidelines in Denmark (Danish Health Authority, 2016; Sundhedsstyrelsen, 2013), recommending 3 months of exercise-based rehabilitation before surgery may be considered. Recommendations regarding exercise therapy duration vary among guidelines and countries (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Diercks et al., 2014; Pedowitz et al., 2011; Hopman et al., 2013), but even with lower cut-points, such as 6 weeks (The Royal College of Surgeons of England, 2014), one third of patients in non-operative care (785 of 2424 patients) would still be considered non-adherent in this study. Collectively, our findings highlight that many patients with long lasting symptoms do not adhere to current guidelines regarding duration of exercise therapy. This finding raises the question whether this is a consequence of inadequate knowledge about these recommendations among healthcare professionals and patients.

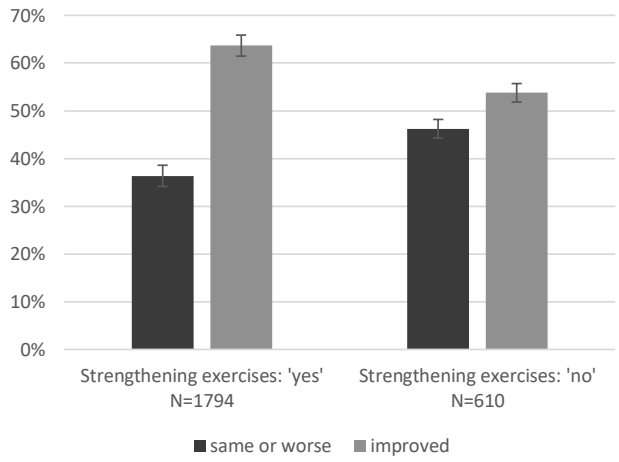

Fig. 2. The proportion of patients reporting unchanged/worse symptoms or improved symptoms, separately for patients having conducted strengthening exercises and those who had not. Error bars depicts 95% confidence intervals for proportions.

4.2. Outcome of care and relevance of specific types of exercise

With only 43% of patients in non-operative care reaching an acceptable symptom state at four months follow-up and 2 out of 5 not improving since diagnosis at the hospital, this study illustrates that treatment of patients with subacromial pain syndrome remains a significant challenge. Our finding that patients who engaged with exercise therapy (any exercise) had a significantly better chance of symptom improvement (OR 1.66, 95%CI 1.32 to 2.10) fits well with existing evidence, favoring exercise-based interventions as treatment for subacromial pain syndrome (Abdulla et al., 2015; Hanratty et al., 2012). However, in the current study, the duration of exercise therapy was not found to influence the chance of improvement (OR 1.05, 95%CI 0.88 to 1.24). This challenges current clinical guidelines and indicates that a time-based cut-point may not be relevant. Our results provide new knowledge about the relevance of specific types of exercise, showing that patients who had conducted strengthening exercises had a significantly better chance of improvement compared to those who had not (OR 1.65 95%CI 1.25 to 2.19). This aligns with the current understanding that subacromial pain syndrome is mainly a muscle-tendon disorder rather than a consequence of mechanical impingement due to structural bony abnormalities (Cuff and Littlewood, 2017; McFarland

Table 4
The relationship between exercise parameters and the odds of improvement. Dependent variable is a dichotomized version of GIC (slightly better/better/much better/recovered vs. unchanged/slightly worse/worse/much worse).

	Univariate		Confounder adjusted[a]		Fully adjusted[b]	
	OR	95%CI	OR	95%CI	OR	95%CI
Any exercise (yes)	1.48	*(1.18–1.86)*	1.66	*(1.32–2.10)*	1.05	*(0.66–1.66)*
Exercises ≥ 12 weeks	0.94	*(0.80–1.10)*	1.05	*(0.88–1.24)*	0.88	*(0.73–1.07)*
Mobility exercise (yes)	1.40	*(1.15–1.69)*	1.54	*(1.25–1.88)*	1.38	*(0.98–1.94)*
Posture exercise (yes)	0.85	*(0.72–1.00)*	0.94	*(0.79–1.12)*	0.77	*(0.63–0.94)*
Strengthening exercise (yes)	1.51	*(1.25–1.82)*	1.69	*(1.39–2.05)*	1.65	*(1.25–2.19)*
Stretching exercise (yes)	1.08	*(0.91–1.28)*	1.15	*(0.96–1.37)*	0.93	*(0.73–1.17)*

[a] Adjusted for age, gender, symptom duration, affected side, education level, and compensation claim.
[b] In addition to[a] also adjusted for all other dependent variables (Any exercise; Exercises ≥ 12 weeks; Mobility exercise; Posture exercise; Strengthening exercise; Stretch exercise).

et al., 2013; Michener et al., 2009). Accordingly, strengthening exercises has the potential to improve muscle-tendon health through various pathways (Folland and Williams, 2007), which could explain why including strengthening exercises as part of the treatment is related to better clinical outcomes. Conversely, we also found that patients who conducted posture correction and/or scapula setting exercises had a significantly lower chance of improvement (OR 0.77, 95%CI 0.63 to 0.94). We do not believe that this implies a damaging effect of this type of exercises but possibly the inclusion of such exercises could lead to a decreased focus on other types of exercise (i.e. strengthening) and hence have an indirect negative effect by reducing the amount of more relevant exercises. This notion of "less is more" aligns with the more general finding that exercise therapy alone is more effective compared to multimodal physiotherapy interventions (Ginnerup-Nielsen et al., 2016).

Interestingly, current care seems to align with our finding that posture correction and/or scapula setting exercises may be less relevant, as this was also the least commonly used type of exercises (57%), while almost nine out of ten had conducted strengthening exercises. This reflects a pattern similar to the preferences of physiotherapists in the United Kingdom (Bury and Littlewood, 2018) but differs from findings by Pieters et al. (2019) in the Netherlands and Belgium where physiotherapists seems to prefer scapula focused exercises more often (71%) and isotonic exercises less often (60%). As comparative studies are lacking (Shire et al., 2017) and clinical guidelines (Danish Health Authority, 2016; The Royal College of Surgeons of England, 2014; Sundhedsstyrelsen, 2013) do not recommend one type of exercise over others, it has not been possible to evaluate the importance of such differences in approaches. Our findings regarding the influence of specific types of exercises therefore provides important information to inform future research and clinical decision-making, indicating that inclusion of strengthening exercises provides a significant benefit, while postural correction and scapula setting should be used more carefully.

4.3. Strengths and limitations

The population-based sampling with responses from 75% of the entire population increases the external validity of our findings, as the risk of sampling bias is very limited. Furthermore, the internal validity of our findings is supported by a thorough validation of the questionnaire used to map the content of care in relation to existing guidelines. It should be noted, however, that the retrospective design leaves a risk of recall bias. This is mainly a concern in relation to regression analyses, and only if patients are believed to answer differently regarding amount and types of exercises depending on their perceived change in symptoms. Further, we cannot exclude the risk of residual confounding in our regression models, why findings regarding the relationship between types of exercise and chance of improvement should be interpreted with caution and must be confirmed in randomized clinical trials. On the other hand, even when adjusting for several different possible confounders, the impact of strength training did not change, which makes residual confounding less likely.

5. Conclusion

The majority of patients diagnosed with subacromial pain syndrome in specialist care settings engages with exercise therapy, but more than half do not adhere to recommendations regarding duration of exercise therapy. Less than half of patients reaches an acceptable symptom state four months after diagnosis in specialist care. Patients conducting strengthening exercises as part of treatment have a significantly higher chance of symptom improvement, while posture correction and/or scapula setting exercises were related to significantly lower chance of improvement.

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Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

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