BMJ Open Sport & Exercise Medicine

Predicting outcomes across treatment settings in patients with shoulder pain referred to physiotherapy: a secondary analysis of two comparable prospective cohort studies

Nikolaj Agger [1,2] François Desmeules [3,4] David Høyrup Christiansen [1,2,5]

To cite: Agger N, Desmeules F, Christiansen DH. Predicting outcomes across treatment settings in patients with shoulder pain referred to physiotherapy: a secondary analysis of two comparable prospective cohort studies. *BMJ Open Sport & Exercise Medicine* 2023;**9**:e001770. doi:10.1136/bmjsem-2023-001770

Accepted 29 November 2023

[1]Centre for Research in Health and Nursing, Regional Hospital Central Jutland Viborg, Viborg, Denmark
[2]Elective Surgery Centre, Silkeborg Regional Hospital, Silkeborg, Denmark
[3]School of Rehabilitation, Medicine Faculty, University of Montreal, Montreal, Quebec, Canada
[4]Maisonneuve-Rosemont Hospital Research Center, Montreal, Quebec, Canada
[5]Department of Clinical Medicine, Aarhus University, Aarhus, Denmark

Correspondence to
Mr Nikolaj Agger;
nikoagger@hotmail.com

ABSTRACT

Objective Previous studies have examined factors that may contribute to predicting outcomes for patients with shoulder pain. However, there is still a lack of consensus on which factors predict the results and whether there are differences based on the treatment setting. Thus, this study aimed to analyse and compare how baseline variables are associated with future outcomes in patients with shoulder pain in primary and secondary care settings.

Methods This study conducted a secondary analysis of two observational prospective cohort studies involving patients with shoulder pain in primary care (n=150) and secondary care (n=183). Multiple regression analyses were employed, with one interaction term at a time, to examine potential differences in association with baseline characteristics and future outcomes between the two settings.

Results Changes in pain and function were statistically significant at 6 months for patients in primary care and secondary care. However, associations for most baseline variables and outcomes did not differ significantly across these two treatment settings. The only statistically significant interactions observed were for the associations between baseline level of pain, function and fear avoidance beliefs and change in pain scores at 6 months, with lower change scores observed among patients in the secondary care.

Conclusion This study revealed that the association with outcomes did not differ across settings for most baseline characteristics. These findings suggest that it could be feasible to generalise the prognostic value of most baseline variables for patients with shoulder, irrespective of the treatment setting.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous research has identified various variables associated with changes in pain and function for patients with shoulder pain. There does not seem to be a consensus on which variables show the strongest association and whether there are differences depending on the setting in which patients are treated.

WHAT THIS STUDY ADDS

⇒ This study adds to the existing research by showing that most baseline variables' association with future outcomes is similar for patients treated in primary and secondary settings. These findings suggest that it could be feasible to generalise the prognostic value of baseline characteristics on future outcomes for most variables for patients with shoulder pain, irrespective of treatment setting.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study could help future research in building more accurate prognostic models and inform patients and decision-makers on what to expect from rehabilitation.

BACKGROUND

Musculoskeletal pain, including shoulder pain, has significant implications at individual and socioeconomic levels.[1] Shoulder pain is the Danish population's third most common musculoskeletal complaint and is primarily treated by physiotherapists in primary care.[2] However, persistent pain may require referral to medical specialists in secondary care. In Denmark, approximately 15 000 patients receive such referrals annually.[3] A considerable proportion of cases experience persistent pain, with about half of the patients seeking multiple consultations for the same episode of shoulder pain.[4] Previously, the cause of shoulder pain was mainly attributed to tissue damage and biomechanical factors. However, current understanding acknowledges that shoulder pain and other musculoskeletal disorders are multifaceted phenomena influenced by various contextual factors, including psychosocial elements.[5] This may explain the variable prognosis of shoulder pain, with up to 50% of patients reporting ongoing pain 6–12 months after consulting a clinician.[6]

The evolving perception of shoulder pain aetiology has prompted studies to explore

whether specific baseline psychosocial and biomechanical variables can predict changes in pain and function among individuals with musculoskeletal pain. In shoulder patients, numerous prognostic factors have been identified,[7 8] but few remain consistent across studies.[9] Differences in patient populations, outcome measures and settings may very well explain these differences. Most previous studies have investigated the predictive value of baseline characteristics separately for primary and secondary care settings.[9] Typically, patients referred to secondary care have already received unsuccessful treatment in primary care, potentially indicating more severe cases with chronic pain presentations. This raises the possibility that primary and secondary care patients might possess distinct prognostic factors, which could carry significant clinical implications for the utilisation of predictive models. To our knowledge, no study has investigated the influence of treatment settings on prognostic factors in patients with shoulder pain. Thus, the aim of this study was to investigate the association between baseline variables and future outcomes in patients with shoulder pain across primary and secondary healthcare settings.

METHODS

Design

As defined by the framework of Kent *et al*,[10] this study was an exploratory prognostic study of individual patient data obtained from two cohort studies of patients referred to physiotherapy treatment in primary[11] and secondary care[12] in Denmark.

The primary cohort data were collected as part of a prospective cohort study that evaluated the utility of standardised electronic data collection tools for patients with neck, shoulder or low-back pain who were referred to physiotherapy treatment in 23 physiotherapy practices across Denmark between January and June 2016. All physiotherapy practices in Denmark (approximately 500) were invited to participate. A total of 26 physiotherapy practices applied for participation, of which three declined participation. Patients were eligible and invited to participate if referred to physiotherapy treatment by their GP, at least 18 years of age and able to understand Danish well enough to complete online questionnaires. Participants were asked to complete a questionnaire before their first consultation and at 3-month and 6-month follow-up, with all questionnaire and clinical data collected using an existing web-based clinical database (FysDB).[11] Only patients with a primary shoulder L08 or L92 diagnosis in ICPC classification were included in this study.

The secondary cohort data were collected between February 2018 and August 2019 in patients with persistent shoulder pain referred to one in six municipal outpatient rehabilitation centres in West Jutland, Denmark, following hospital treatment. Eligible patients were those at least 18 years old and able to understand Danish well enough to complete questionnaires. Participants who agreed to participate were asked to complete an online questionnaire before their first consultation. They were notified by email when follow-up questionnaires at 2, 4 and 6 months were available. Data collection was administered by an online clinical database (Trial Partner).[12] Only patients with a primary diagnosis of the shoulder ICD-10 classification DM750-759 or DM254-256 were included, excluding all surgically treated patients.

In both cohorts, no attempt to control the intervention was made, as the treating physiotherapists made any decision regarding the type of intervention based on their clinical judgement. Data were collected through online questionnaires containing questions from validated outcome measures. Follow-up was conducted at 3 and 6 months for the 'primary' cohort and at 2, 4 and 6 months for the 'secondary' cohort. In this study, only the 6-month follow-up data were used.

Candidate predictors

Candidate predictors were selected based on the existing literature regarding the potential biopsychosocial variables that could influence the course of treatment and availability in the two cohorts. The following baseline variables were included: age (continuous), gender (M/F), work status (employed/unemployed), educational level ('unskilled', 'vocational', 'lower', 'medium or higher'), pain duration ('0–3 months', '4–6 months', '>6 months'), mental health as measured by the WHO-5 Index,[13] and scores on: fear avoidance (0–20), coping (0–10), self-perceived risk of chronicity (0–10), all as measured by selected questions from the ÖMPQ.[14 15]

The ÖMPQ has shown acceptable measurement properties in terms of test–retest reliability and absolute reliability.[16] The WHO-5 has adequate validity in assessing the subjective well-being of patients.[13]

Outcome measures

The outcomes assessed in this study included pain, function and satisfactory outcome collected at baseline and 6-month follow-up. Pain was evaluated using the Numeric Pain Rating Scale. This validated instrument prompts patients to rate their typical pain over the previous 2 weeks on a scale of 0–10, with 10 representing the highest imaginable pain.[17]

Function was assessed using the Quick-Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH), a shortened version of the original questionnaire that measures upper limb physical disabilities and symptoms. The QuickDASH questionnaire comprises 11 items that are condensed into a total score ranging from 0 (no disability) to 100 (most severe disability) and is considered to have adequate reliability, validity and sensitivity to measure changes in disability among patients with shoulder disorders.[18 19] Satisfactory outcome was collected through patient acceptable symptom state (PASS). PASS is a single-question outcome measure that assesses the symptoms at which the patient considers themselves well. Patients were asked to respond to the question, 'If you were to remain in your current state for the next few

months, would you consider your current state to be satisfactory?' with a dichotomous response of 'yes' or 'no'. No baseline measure of PASS was collected.[20]

Data analysis

Both cohorts used identical questionnaires, apart from the pain duration question, which was measured continuously in the secondary cohort and categorised in the primary cohort. To facilitate meaningful comparisons, the data in the secondary cohort were also categorised, resulting in three categories. Descriptive statistics were calculated for all variables. Change scores from baseline to follow-up for pain and function were calculated by subtracting the follow-up score from the baseline score. Positive change scores indicated an improvement, and negative scores indicated aggravation. A Spearman correlation test was conducted to assess the correlation between variables. As no variables demonstrated a high correlation (r>0.7), all the variables mentioned earlier were included in our analyses. All prerequisites for conducting linear and logistic regression analyses were satisfied. First, regression models were computed with 'setting' as the determinant to investigate differences in outcome between primary and secondary settings, only adjusting for the baseline of the outcome measure investigated, as baseline levels often are found to be the strongest predictors of future pain and disability.[21–23] Afterwards, all baseline variables listed above were added to the regression models to investigate the association between baseline values and outcome measures of pain, function and satisfactory outcome. Interaction terms (baseline characteristic setting) for all prognostic factors with setting were added to the models to investigate to what extent the association between the baseline characteristic and the outcome varied between primary care and secondary care. A single interaction term was incorporated at a time to guarantee that the models possessed adequate statistical power, with the previous one being substituted by the subsequent term.

Finally, a sensitivity analysis was performed to assess result robustness. Our hypothesis posited that systematic dropout could primarily affect individuals with unfavourable outcomes. To address potential bias, patients lost to follow-up were assigned 0 for pain and function change scores and 'no' for PASS. This approach aimed to mitigate dropout effects on our study findings.

The level of significance was set at 0.05. Statistical software, Stata V.17, was used to analyse data.[24]

Equity, diversity and inclusion statement

Diversity was prioritised throughout our study. Recruitment aimed for representation across various sociodemographic factors. Our author team values diverse perspectives. Equity is central in our analysis, addressing disparities and challenges.

RESULTS

This analysis included a sample of 333 participants (see figure 1). Table 1 provides an overview of the baseline characteristics of the study participants. A greater proportion of participants in the primary cohort were classified as employed, whereas a higher percentage of participants

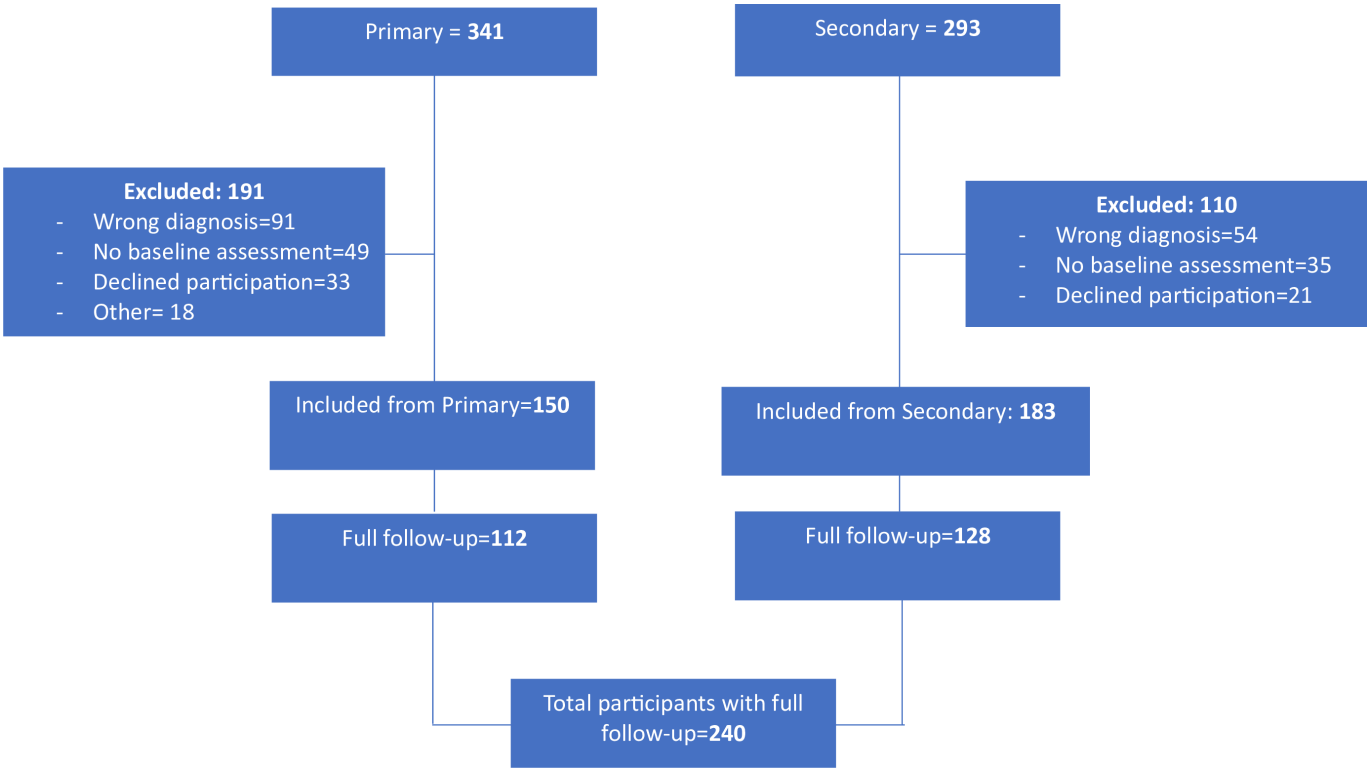

Figure 1 Flow of participants.

Table 1 Baseline characteristics of participants

Characteristics	Total (n=333)	Primary (n=150)	Secondary (n=183)
Gender, n (%)			
Female	188 (56.5%)	84 (56.0%)	104 (56.8%)
Male	145 (43.5%)	66 (44.0%)	79 (43.2%)
Age, mean (SD)	52.7 (14.3)	51.5 (13.8)	53.7 (14.7)
Educational level, n (%)			
Unskilled	49 (14.8%)	21 (14.1%)	28 (15.3%)
Vocational	120 (36.1%)	62 (41.6%)	58 (31.7%)
Lower	60 (18.1%)	21 (14.1%)	39 (21.3%)
Medium or higher	103 (31.0%)	45 (30.2%)	58 (31.7%)
Work status, n (%)			
Employed	185 (56.2%)	105 (71.0%)	81 (44.3%)
Unemployed	145 (43.8%)	43 (29.0%)	102 (55.7%)
Pain duration, months, n (%)			
0–3	83 (27.7%)	64 (42.7%)	19 (12.7%)
4–6	57 (19.0%)	34 (22.6%)	23 (15.3%)
>6	160 (53.3%)	52 (34.7%)	108 (72.0%)
QuickDASH baseline (0–100), mean (SD)	37.0 (18.0)	35.2 (17.6)	38.0 (18.4)
Pain baseline NRS 0–10, mean (SD)	5.5 (2.1)	5.6 (2.0)	5.5 (2.2)
Risk of chronicity ÖMPQ 0–10, mean (SD)	6.4 (2.7)	6.4 (2.6)	6.4 (2.8)
Coping ÖMPQ 0–10, mean (SD)	6.0 (2.4)	6.0 (2.4)	6.0 (2.4)
Fear-avoidance ÖMPQ 0–20, mean (SD)	12.2 (5.1)	11.3 (5.4)	12.9 (4.8)
Mental health WHO-5 0–100, mean (SD)	59.4 (20.6)	61.5 (17.9)	57.6 (22.7)

N, number of patients; NRS, Numeric Rating Scale; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

in the secondary cohort reported experiencing pain for a duration exceeding 6 months. However, no substantial differences were observed between the two cohorts for most baseline characteristics.

Clinical course

Overall, the participants experienced improvements in pain and function, but only approximately half were satisfied with their state after 6 months (see figures 2 and 3). The analyses adjusted for the baseline value of the outcome measure in question revealed statistically significant differences between the two cohorts, as the secondary cohort had lower change scores and a lower likelihood of reporting satisfactory outcome (see table 2).

Associations between baseline values and outcome measures

On further adjustment for all baseline variables, statistically significant differences in outcomes persisted between the two treatment settings, except for pain change (see table 3). Patients with a pain duration exceeding 6 months exhibited statistically significant lower change scores in both pain and function compared with those with a pain duration ranging from 0 to 3 months. Additionally, QuickDASH score and WHO-5 score were statistically significantly associated with change in QuickDASH, while baseline pain demonstrated a statistically significant association with change in pain. None of the associations of the remaining variables included in the analysis achieved statistical significance when accounting for the influence of other baseline variables.

Difference in associations across settings

The results of the analyses investigating the interactions between all baseline variables and treatment settings on outcome measures are reported in table 4. Notably, the associations between baseline characteristics of pain level, QuickDASH level and fear avoidance and outcome measure QuickDASH-change showed statistically significant differences between the two treatment settings. In these instances, the baseline variable was linked to a worse outcome in secondary care when compared with primary care. There were no significant differences for the remaining interaction terms.

Sensitivity analysis

The sensitivity analysis produced consistent findings with the main analysis, except for the variable ‘gender’, which demonstrated a statistically significant difference in association with pain change between settings (see table 5).

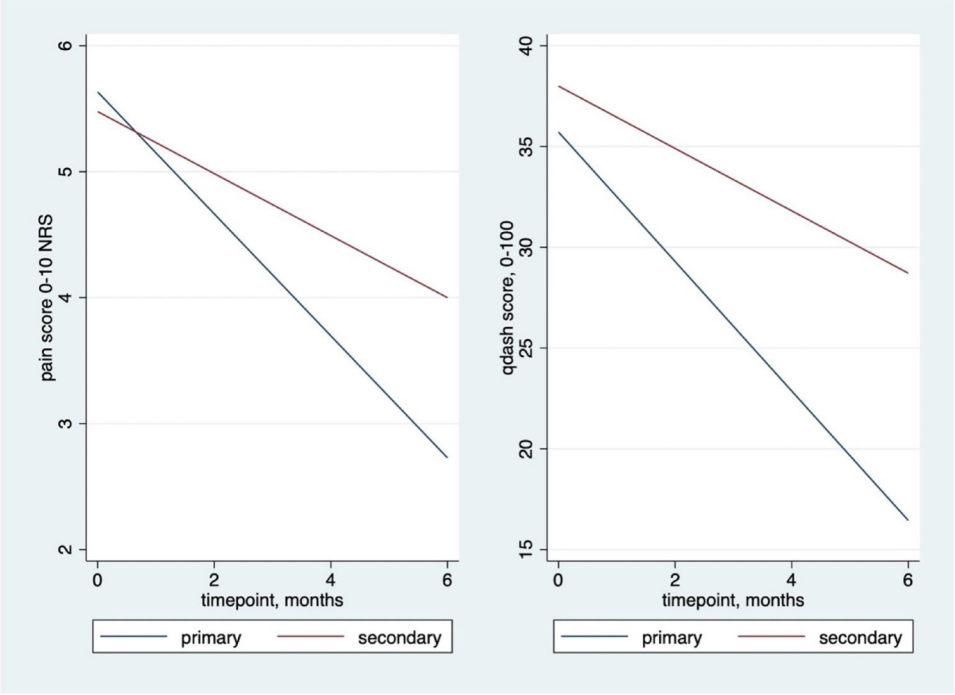

Figure 2 Trajectory of participants' pain and function based on treatment setting stratification. NRS, Numeric Rating Scale; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

DISCUSSION

This study aimed to compare the association between baseline characteristics and rehabilitation outcomes among patients with shoulder pain in primary and secondary care settings. The findings indicated that patients receiving treatment in the primary care cohort experienced more significant improvements in pain and function and were more likely to achieve satisfactory outcomes than those treated in the secondary care cohort. Despite these differences,

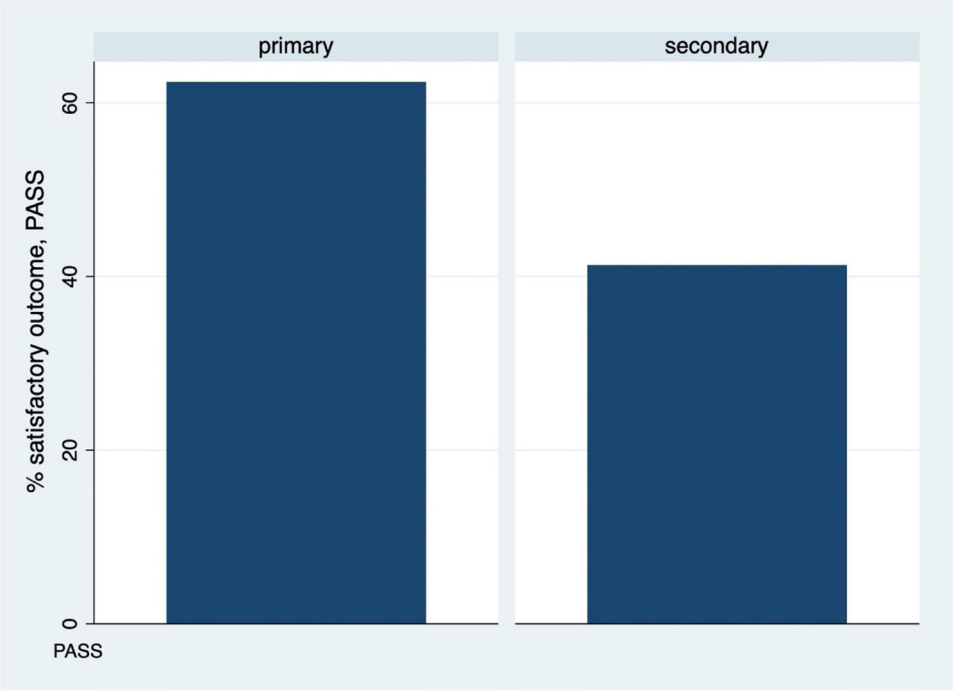

Figure 3 Distribution of participants achieving satisfactory outcome at 6 months, stratified by treatment setting. PASS, patient acceptable symptom state.

Table 2 Analyses adjusted for baseline values of outcome measures at 6 months

Setting	QuickDASH-change* mean difference (95% CI)	Pain-change** mean difference (95% CI)	PASS crude OR (95% CI)
Primary	0 (base)	0 (base)	1.0 (base)
Secondary	−11.09 (−15.19 to −6.99)***	−1.40 (−1.98 to −0.81)***	0.42 (0.26 to 0.70)***

Adjusted for: *baseline QuickDASH, **baseline pain, ***p<0.05.
OR: chance of having satisfactory outcome.
PASS, Patient acceptable symptom state; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

most variables demonstrated similar associations with outcomes across the two treatment settings. Only the baseline scores of pain intensity, disability and fear avoidance exhibited a statistically significant difference in association with future outcomes between primary and secondary care. Surprisingly, no significant differences were observed at baseline regarding pain, function, self-perceived risk of chronicity, coping, fear avoidance and mental health between the two settings. Only a few variables showed statistically significant associations with outcomes in the studied populations.

Comparison with existing literature

To our knowledge, this is the first study to investigate the difference in association between baseline characteristics

Table 3 Multivariable associations between baseline values and outcome measures

Baseline variable	QuickDASH-change mean difference (95% CI)	Pain-change mean difference (95% CI)	PASS OR (95% CI)
Gender			
Female	0 (base)	0 (base)	1 (base)
Male	1.05 (−3.95 to 6.04)	−0.09 (−0.79 to 0.62)	0.91 (0.46 to 1.79)
Age	−0.05 (−0.23 to 0.13)	−0.01 (−0.03 to 0.02)	1.01 (0.98 to 1.03)
Educational level			
Unskilled	0 (base)	0 (base)	1 (base)
Vocational	2.23 (−4.52 to 8.98)	0.64 (−0.31 to 1.59)	1.33 (0.52 to 3.42)
Lower level	1.63 (−6.96 to 10.22)	−0.10 (−1.32 to 1.11)	1.38 (0.43 to 4.44)
Medium or higher	1.59 (−5.36 to 8.53)	0.93 (−0.06 to 1.91)	1.60 (0.61 to 4.19)
Work status			
Employed	0 (base)	0 (base)	1 (base)
Unemployed	−2.92 (−7.71 to 1.88)	−0.31 (−0.99 to 0.37)	1.20 (0.61 to 2.32)
Pain duration, months			
0–3	0 (base)	0 (base)	1 (base)
4–6	−0.31 (−7.12 to 6.51)	−0.30 (−1.25 to 0.66)	1.48 (0.58 to 3.77)
>6	−6.28(−12.53 to −0.02)*	−1.16 (−2.04 to −0.29)*	0.73 (0.32 to 1.68)
QuickDASH baseline	0.52 (0.35 to 0.71)*	−0.01 (−0.04 to 0.02)	0.99 (0.96 to 1.01)
Pain baseline	−0.28 (−1.72 to 1.16)	0.67 (0.47 to 0.88)*	0.93 (0.76 to 1.13)
Risk of chronicity	−0.82 (−1.79 to 0.16)	−0.08(−0.22 to 0.06)	0.91 (0.79 to 1.04)
Coping	0.57 (−0.56 to 1.72)	0.04 (−0.12 to 0.21)	1.04 (0.88 to 1.21)
Fear-avoidance	−0.13 (−0.64 to 0.38)	0.01 (−0.07 to 0.08)	1.00 (0.93 to 1.07)
Mental health WHO-5	0.14 (0.01 to 0.27)*	0.01 (−0.01 to 0.03)	1.01 (0.46 to 1.79)
Setting			
Primary	0 (base)	0 (base)	1 (base)
Secondary	−7.65 (−12.90 to −2.39)*	−0.71 (−1.44 to 0.03)	0.36 (0.18 to 0.74)*

Adjusted for all baseline variables. *p<0.05.
OR: chance of having satisfactory outcome.
PASS, patient acceptable symptom state; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

Table 4 Interaction terms between setting and each baseline variable

Baseline variables	Setting	QuickDASH-change mean difference (95% CI)	Pain-change mean difference (95% CI)	PASS OR (95% CI)
Sex	Primary	0 (base)	0 (base)	1 (base)
	Secondary (male)	5.26 (–3.62 to 14.12)	0.81 (–0.45 to 2.06)	1.08 (0.27 to 1.70)
Age	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–0.29 (–0.62 to 0.04)	0.01 (–0.03 to 0.06)	0.98 (0.93 to 1.02)
Education	Primary	0 (base)	0 (base)	1 (base)
	Secondary (vocational)	4.15 (–9.19 to 17.49)	0.39 (–1.50 to 2.28)	1.13 (0.18 to 7.24)
	Secondary (lower)	0.85 (–15.94 to 17.63)	–0.40 (–2.80 to 2.00)	0.83 (0.08 to 8.29)
	Secondary (med-high)	–7.32 (–20.73 to 6.09)	0.03 (–1.89 to 1.94)	0.48 (0.07 to 3.15)
Work	Primary	0 (base)	0 (base)	1 (base)
	Secondary (unemployed)	0.48 (–8.77 to 9.73)	–0.36 (–1.67 to 0.95)	0.51 (0.14 to 1.85)
Pain duration	Primary	0 (base)	0 (base)	1 (base)
	Secondary (4–6)	2.33 (–11.89 to 16.54)	0.62 (–1.37 to 2.61)	0.96 (0.14 to 6.77)
	Secondary (>6)	6.72 (–5.31 to 18.74)	1.19 (–0.49 to 2.88)	1.36 (0.26 to 7.13)
Baseline-QuickDASH	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–0.44 (–0.68 to –0.20)*	–0.03 (–0.06 to 0.01)	0.98 (0.94 to 1.02)
Baseline pain	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–3.69 (–5.82 to –1.55)*	–0.08 (–0.39 to 0.23)	0.88 (0.65 to 1.20)
Risk of chronicity	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–1.18 (–2.89 to 0.52)	0.01 (–0.23 to 0.25)	0.94 (0.74 to 1.20)
Coping	Primary	0 (base)	0 (base)	1 (base)
	Secondary	0.79 (–1.19 to 2.78)	–0.09 (–0.37 to 0.19)	0.94 (0.71 to 1.25)
Fear-avoidance	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–1.25 (–2.10 to –0.39)*	–0.08 (–0.20 to 0.05)	0.95 (0.84 to 1.07)
Mental health, WHO-5	Primary	0 (base)	0 (base)	1 (base)
	Secondary	0.21 (–0.01 to 0.44)	0.02 (–0.01 to 0.05)	1.01 (0.98 to 1.05)

Adjusted for all baseline variables. *p<0.05.
OR: chance of having satisfactory outcome.
PASS, patient acceptable symptom state; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

and outcomes across two treatment settings in patients with shoulder pain. Previous studies have investigated the predictive value of baseline characteristics separately for primary and secondary care settings, and a systematic review by Kooijman *et al* compiled the findings of some of these studies.[9] The review found that higher shoulder pain intensity, concomitant neck pain and longer symptom duration were predictive of poorer outcomes in primary care settings. In contrast, disability and previous shoulder pain were predictive of poorer outcomes in secondary care populations. Our study's findings align with prior research, highlighting the association of pain intensity, pain duration and disability with outcome measures related to pain and function. However, there is considerable variation in which predictors are accurate in the existing literature. Some variables are found to be predictors in both settings, while others only are found to predict accurately in a specific setting. Some variables may even predict outcomes in different directions. For example, some studies found that female gender and pain intensity predict poorer outcomes,[25–28] while others found that they predict favourable outcomes.[9 26] The complexity of musculoskeletal pain, influenced by various psychosocial, contextual and biomechanical factors, may explain the variation in results. Additionally, differences in study methods and outcome measures make it challenging to compare results across studies. This study adds to the existing research by showing that most baseline variables included in this study have similar associations with future outcomes, regardless of whether patients are treated in primary or secondary care.

Surprisingly, no significant differences in pain, function, self-perceived risk of chronicity, coping, fear avoidance and mental health were observed between the settings at baseline. As hypothesised in the introduction, patients treated in secondary care had experienced pain

Table 5 Worst case sensitivity analyses: interaction terms between setting and each baseline variable, including all patients lost to follow-up receiving change scores of 0 and 'no' in PASS

Baseline variable	Setting	QuickDASH-change mean difference (95% CI)	Pain-change mean difference (95% CI)	PASS OR (95% CI)
Gender	Primary	0 (base)	0 (base)	1 (base)
	Secondary (male)	6.74 (–0.76 to 14.25)	1.30 (0.24 to 2.34)*	2.58 (0.86 to 7.71)
Age	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–1.14 (–0.41 to 0.14)	0.00 (–0.02 to 0.03)	1.00 (0.96 to 1.04)
Educational level	Primary	0 (base)	0 (base)	1 (base)
	Secondary (vocational)	4.15 (–7.30 to 15.60)	0.11 (–1.52 to 1.73)	0.97 (0.18 to 5.27)
	Secondary (lower)	1.35 (–12.22 to 14.93)	0.11 (–1.81 to 2.04)	1.40 (0.18 to 10.79)
	Secondary (med-high)	–4.65 (–16.45 to 7.15)	0.12 (–1.56 to 1.79)	0.65 (0.11 to 3.67)
Work	Primary	0 (base)	0 (base)	1 (base)
	Secondary (unemployed)	0.05 (–7.87 to 7.97)	–0.41 (–1.52 to 0.71)	0.72 (0.23 to 2.25)
Pain duration	Primary	0 (base)	0 (base)	1 (base)
	Secondary (4–6)	–0.60 (–12.88 to 11.68)	0.51 (–1.22 to 2.23)	1.10 (0.19 to 6.31)
	Secondary (>6)	5.40 (–5.05 to 15.86)	1.04 (–0.43 to 2.51)	1.90 (0.43 to 8.48)
Baseline QuickDASH	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–0.28 (–0.48 to –0.07)*	–0.02 (–0.05 to 0.01)	0.98 (0.95 to 1.02)
Baseline pain	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–2.70 (–4.52 to –0.89)*	–0.07 (–0.33 to 0.19)	0.91 (0.70 to 1.20)
Risk of chronicity	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–0.74 (–2.18 to 0.70)	0.02 (–0.18 to 0.23)	0.91 (0.74 to 1.12)
Coping	Primary	0 (base)	0 (base)	1 (base)
	Secondary	0.66 (–0.91 to 2.24)	–0.03 (–0.25 to 0.19)	1.01 (0.79 to 1.28)
Fear-avoidance	Primary	0 (base)	0 (base)	1 (base)
	Secondary	–0.85 (–1.58 to 0.13)*	–0.07 (–0.18 to 0.03)	0.95 (0.85 to 1.05)
Mental health	Primary	0 (base)	0 (base)	1 (base)
	Secondary	0.08 (–0.11 to 0.27)	0.01 (–0.02 to 0.03)	1.00 (0.98 to 1.03)

Adjusted for all baseline variables. *p<0.05.
OR: chance of having satisfactory outcome.
PASS, patient acceptable symptom state; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

longer than those treated in primary care. Pain lasting over 3 months is widely categorised as chronic and can lead to undesirable physiological changes to the nervous system, making it less reversible. Therefore, patients with longer pain durations were expected to be the most affected in terms of pain, function and psychosocial parameters. However, this assumption was not observed in this study. These findings contradict the initial hypothesis that patients treated in secondary care would represent more severe cases. This is in contrast to a previous study conducted in the Danish healthcare system examining patients with low back pain in primary and secondary care. Their results demonstrated significant differences in demographic and clinical characteristics between the two groups, as secondary care patients were identified as more severe cases.[29] These discrepancies between shoulder and low back patients need further investigation.

Strengths and limitations

A notable strength of this study is that the data is obtained using similar methods and identical scales in both cohorts. This decreases the risk of information bias. Furthermore, both cohorts were obtained from real-world intervention settings without any attempt to control or influence the treatment process. This increases the validity and generalisability of our results, as the two populations reflect clinical practice.

Although refraining from controlling or influencing the treatment procedure contributes to enhanced generalisability, it may concurrently introduce a potential bias owing to variations in the quantity and nature of

treatments across the two healthcare settings. Additionally, our study focused solely on physiotherapy patients, potentially limiting the general applicability of our findings. Nevertheless, since the primary objective of this study was not to establish causal relationships but rather to explore whether distinctions exist in how certain variables are associated with future outcomes within two distinct healthcare settings, it is presumed that the study's validity remains uncompromised.[10]

The multifaceted nature of pain and the variability of accurate predictors in the existing literature creates challenges in ensuring that all pertinent variables are incorporated in this study. Although it could have been appropriate to include more covariates in our analyses, we lacked information on some variables that demonstrated predictive value in previous research. Nonetheless, since the primary objective was not to develop a prognostic model, we do not believe the validity of our findings to be compromised. Our study's findings indicate that only a small number of variables demonstrate a significant difference in the association between baseline characteristics and outcomes across settings. This limited number of significant variables may be due to the relatively small sample size. Therefore, it is important to consider whether type 2 errors may influence the results. To confirm the robustness of this study's results, it is necessary to conduct further research with larger sample sizes and longer follow-up periods.

The study indicated a completion rate of 72%, highlighting the concern of potential bias arising from participant dropouts. A 'worst case' sensitivity analysis was conducted to mitigate this risk. The sensitivity analysis yielded consistent results with the main analysis. These findings suggest that even if attrition bias is present, it is unlikely to have influenced study results.

Clinical implications

Ultimately, most baseline variables seem to exhibit similar associations with future outcomes, regardless of where patients are treated. This implies that it may be possible to generalise the prognostic ability of most baseline values for individuals experiencing shoulder pain. This knowledge can support future investigations in constructing more precise prognostic models and provide patients and decision-makers with valuable insights into rehabilitation expectations. The results of this study also propose that targeting modifiable prognostic factors that apply broadly to shoulder pain could be more advantageous than focusing on a particular treatment setting.

CONCLUSION

Our study aimed to explore potential differences in the association between baseline characteristics and future outcomes among patients with shoulder pain in primary and secondary rehabilitation care settings. The analysis indicated that most baseline variables had no discernible distinction in their associations with future outcomes between the two healthcare settings. These findings suggest that the association between most baseline variables and rehabilitation outcomes for patients with shoulder pain does not seem to differ across treatment settings.

Contributors NA analysed the data and wrote the main part of the manuscript. FD provided guidance on the research design, data interpretation, and contributed to writing and critically reviewing the manuscript. DHC collected data, conceived the study and the research design, provided guidance on data interpretation, and contributed to writing and critically reviewing the manuscript. All authors have read and approved the final manuscript. NA serves as the guarantor for the overall content of this work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval No ethics approval was needed since participation did not affect referral and treatment pathways. The study was performed in line with the ethical principles of the Declaration of Helsinki. All participants gave written informed consent to participate. The original studies were approved by the Danish Data Protection Agency and thus complied with the rules on protection of personal data (primary no. 2012-58-006, secondary no. 1-16-02-9-18).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

ORCID iDs
Nikolaj Agger http://orcid.org/0009-0006-1060-9292
François Desmeules http://orcid.org/0000-0002-0290-7031
David Høyrup Christiansen http://orcid.org/0000-0001-7458-3921

REFERENCES

1 Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ* 2003;81:646–56.
2 Holmberg T. PMJ, Davidsen M. Muskel- og skeletlidelser I Danmark. Nøgletal 2015. Statens Institut for Folkesundhed: Syddansk Universitet; 2015.
3 Christiansen DH, Frost P, Frich LH, *et al*. The use of physiotherapy among patients with subacromial Impingement syndrome: impact of sex, socio-demographic and clinical factors. *PLoS One* 2016;11:e0151077.
4 Laslett M, Steele M, Hing W, *et al*. Shoulder pain in primary care--part 2: predictors of clinical outcome to 12 months. *J Rehabil Med* 2015;47:66–71.
5 Turk DC, Okifuji A. Psychological factors in chronic pain: evolution and revolution. *J Consult Clin Psychol* 2002;70:678–90.
6 Major DH, Røe Y, Småstuen MC, *et al*. Fear of movement and emotional distress as prognostic factors for disability in patients with shoulder pain: a prospective cohort study. *BMC Musculoskelet Disord* 2022;23:183.
7 Artus M, Campbell P, Mallen CD, *et al*. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. *BMJ Open* 2017;7:e012901.
8 de Vos Andersen N-B, Kent P, Hjort J, *et al*. Clinical course and prognosis of musculoskeletal pain in patients referred for physiotherapy: does pain site matter *BMC Musculoskelet Disord* 2017;18:130.
9 Kooijman MK, Barten D-JA, Swinkels ICS, *et al*. Pain intensity, neck pain and longer duration of complaints predict poorer outcome in patients with shoulder pain--a systematic review. *BMC Musculoskelet Disord* 2015;16:288.

10 Kent P, Cancelliere C, Boyle E, *et al*. A conceptual framework for prognostic research. *BMC Med Res Methodol* 2020;20:172.
11 Budtz CR, Mose S, Christiansen DH. Socio-demographic, clinical and psychological predictors of healthcare utilization among patients with musculoskeletal disorders: a prospective cohort study. *BMC Health Serv Res* 2020;20:239.
12 Rønnow MM, Stæhr TAB, Christiansen DH. Predicting change in symptoms and function in patients with persistent shoulder pain: a prognostic model development study. *BMC Musculoskelet Disord* 2021;22:855.
13 Topp CW, Østergaard SD, Søndergaard S, *et al*. The WHO-5 well-being index: a systematic review of the literature. *Psychother Psychosom* 2015;84:167–76.
14 Hockings RL, McAuley JH, Maher CG. A systematic review of the predictive ability of the Orebro musculoskeletal pain questionnaire. *Spine* 2008;33:E494–500.
15 Linton SJ, Boersma K. Early identification of patients at risk of developing a persistent back problem: the predictive validity of the Orebro musculoskeletal pain questionnaire. *Clin J Pain* 2003;19:80–6.
16 Oxfeldt M. Danish short form Örebro musculoskeletal pain screening questionnaire – translation, cross-cultural adaptation, and reliability [Student thesis]. 2017
17 Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. *J Clin Nurs* 2005;14:798–804.
18 Schønnemann JO, Eggers J. Validation of the Danish version of the quick-disabilities of arm, shoulder and hand questionnaire. *Dan Med J* 2016;63:A5306.
19 Budtz CR, Andersen JH, de Vos Andersen N-B, *et al*. Responsiveness and minimal important change for the quick-DASH in patients with shoulder disorders. *Health Qual Life Outcomes* 2018;16:226.
20 Tubach F, Wells GA, Ravaud P, *et al*. Minimal clinically important difference, low disease activity state, and patient acceptable symptom state: methodological issues. *J Rheumatol* 2005;32:2025–9.
21 Gustavsson C, Bergström J, Denison E, *et al*. Predictive factors for disability outcome at twenty weeks and two years following a pain self-management group intervention in patients with persistent neck pain in primary health care. *J Rehabil Med* 2013;45:170–6.
22 Campbell P, Foster NE, Thomas E, *et al*. Prognostic indicators of low back pain in primary care: five-year prospective study. *J Pain* 2013;14:873–83.
23 Bot SDM, van der Waal JM, Terwee CB, *et al*. Predictors of outcome in neck and shoulder symptoms: a cohort study in general practice. *Spine (Phila Pa 1976)* 2005;30:E459–70.
24 Stata. Stata. Statistical software programme. College Station, TX StataCorp LLC; 2021.
25 van der Windt DA, Koes BW, Boeke AJ, *et al*. Shoulder disorders in general practice: prognostic indicators of outcome. *Br J Gen Pract* 1996;46:519–23.
26 Kennedy CA, Manno M, Hogg-Johnson S, *et al*. Prognosis in soft tissue disorders of the shoulder: predicting both change in disability and level of disability after treatment. *Phys Ther* 2006;86:1013–32;
27 Kuijpers T, van der Windt DAWM, Boeke JPA, *et al*. Clinical prediction rules for the prognosis of shoulder pain in general practice. *Pain* 2006;120:276–85.
28 Thomas E, van der Windt DAWM, Hay EM, *et al*. Two pragmatic trials of treatment for shoulder disorders in primary care: generalisability, course, and prognostic indicators. *Ann Rheum Dis* 2005;64:1056–61.
29 Hansen A, Morsø L, Stochkendahl MJ, *et al*. Demographic and clinical characteristics of patients with low back pain in primary and secondary care settings in Southern Denmark. *Scand J Prim Health Care* 2023;41:152–9.