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OXFORD

Clinical science

Comparison of health-care utilization, costs and health-related quality of life across the subgroups defined by the Keele STarT MSK Tool

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Abstract

Objectives: The aim of this study was to describe and compare health economic outcomes [health-care utilization and costs, work outcomes, and health-related quality of life (EQ-5D-5L)] in patients classified into different levels-of-risk subgroups by the Keele STarT MSK Tool.

Methods: Data on health-care utilization, costs and EQ-5D-5L were collected from a health-care perspective within a primary care prospective observational cohort study. Patients presenting with one (or more) of the five most common musculoskeletal pain presentations were included: back, neck, shoulder, knee or multi-site pain. Participants at low, medium and high risk of persistent disabling pain were compared in relation to mean health-care utilization and costs, health-related quality of life, and employment status. Regression analysis was used to estimate costs.

Results: Over 6 months, the mean (s.b.) total health-care (National Health Service and private) costs associated with the low, medium, and high-risk subgroups were £132.92 (167.88), £279.32 (462.98) and £476.07 (716.44), respectively. Mean health-related quality of life over the 6-month period was lower and more people changed their employment status in the high-risk subgroup compared with the medium- and low-risk subgroups.

Conclusions: This study demonstrates that subgroups of people with different levels of risk for poor musculoskeletal pain outcomes also have different levels of health-care utilization, health-care costs, health-related quality of life, and work outcomes. The findings show that the STarT MSK Tool not only identifies those at risk of a poorer outcome, but also those who will have more health-care visits and incur higher costs.

Keywords: costs, musculoskeletal pain, stratified care, EQ-5D

Rheumatology key messages

- The Keele STarT MSK Tool was developed to stratify patients with musculoskeletal pain into subgroups.
- Patients identified as being at high risk of persistent disabling pain incurred greater health-care costs compared with those in other subgroups.
- Patients in the high-risk subgroup were associated with lower health-related quality of life.

Introduction

Musculoskeletal pain is common, and the prevalence of persistent musculoskeletal pain is high (25-32%). It can affect all sites of the body; most commonly the back, neck, shoulder, knee, or multiple sites [1]. The burden of musculoskeletal pain is reflected in high health-care use, with $\sim 20\%$ of a typical primary-care population consulting about musculoskeletal pain annually [2]. Conditions such as low back pain are among the leading causes of years lived with disability, representing a significant global burden [3-4]. It has been noted that musculoskeletal pain is one of the key drivers of the costs associated with work absence, and estimates have shown that musculoskeletal conditions account for 20% of sickness certificates in primary care [5].

Most patients with musculoskeletal pain are managed within primary care [6–7], and an approach that categorizes these patients based on their risk of persistent disabling pain and matches each subgroup to different treatments, known as

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STarT Back stratified care [8–9], has previously been shown to be effective and cost-effective for low back pain in the UK National Health Service (NHS) setting [10–11]. Several systematic reviews have shown that the prognostic factors that predict poor outcome in low back pain are similar to those that predict outcome across a range of common musculoskeletal pain presentations (back, neck, knee, shoulder and multi-site pain) [12-13]. The Keele STarT MSK Tool was developed and validated to stratify patients into three subgroups (low risk, medium risk and high risk) in those who consult with one or more of the five most common musculoskeletal pain presentations in primary care [14, 15]. The validation study showed that the Keele STarT MSK Tool predicts persistent pain and disability at 2 and 6 months follow-up [14]. In addition to the validation study, it is also important to establish the health economic costs and outcomes associated with each of the subgroups. This provides useful information for decision-makers on the expected health-care resources required by these patients, and also establishes baseline information for intervention studies.

The aim of this study was to describe health economic outcomes (health-care utilization and costs, work outcomes, and health-related quality of life) associated with patients classified into risk subgroups based on the Keele STarT MSK Tool.

Methods

The economic analysis was carried out alongside a prospective primary care cohort study called the Keele Aches and Pains Study (KAPS) [15] and adopted a health-care perspective (NHS and private costs). In the KAPS study, participants aged 18 years and above presenting with one (or more) of the five most common musculoskeletal pain presentations: back, neck, shoulder, knee or multi-site pain were recruited from 12 general practices in Staffordshire and the West Midlands between July 2014 and February 2015. Full details of the eligibility criteria, methods of identification, invitation, consent and data collection, are published elsewhere [14]. The Keele STarT MSK Tool was included in patient questionnaires (at the baseline, 2-months and 6-months follow-up points). This was used to stratify participants into three risk subgroups (low, medium and high risk of persistent disabling pain) using cut-off points based on predictive values, likelihood ratios, sensitivity and specificity for predicting pain intensity, and self-reported physical health [14]. The protocol for this study has been published previously [15]. The economic analysis was based on the 1890 participants who consented to participate and returned the baseline postal questionnaires.

Health-care utilization data

Health-care utilization data were collected from questionnaires completed by each participant and a review of the medical records (including data on prescribed medication related to the musculoskeletal pain problem) of those who had given consent. Information on health-care utilization relating to the participant's musculoskeletal pain was collected from their 6-month follow-up questionnaire. NHS health-care utilization for musculoskeletal pain included primary and secondary care contacts and treatments, tests and investigations, and contacts with other health-care professionals such as physiotherapists, rheumatologists, and orthopaedic surgeons. Health-care utilization associated with the participants' personal expenditure focused on private health-care use such as osteopathy and over-the-counter (OTC) treatments such as medication. Data from the time period from approximately when the patient presented at their general practice about their musculoskeletal pain, up to a period of 6 months after this date, were used for analysis.

Work outcomes

Data on employment status were collected from the 6-month follow-up questionnaire, where participants provided information on their current employment status (employed: yes/ no), whether their usual employment duties had changed due to pain, and employment satisfaction. Descriptive statistics were used to summarize employment status.

Unit costs

Unit costs associated with items of health-care utilization were obtained primarily from standard national sources such as the British National Formulary (BNF) for prescribed medication, NHS Reference costs for investigations and the Personal Social Services Research Unit publication on Unit Costs of Health and Social Care for items such as visits to health-care professionals [16–18]. Participants also self-reported information on out-of-pocket costs related to the use of OTC medications, including costs paid for medication. In cases where participants did not provide costs for their medication(s), we used unit costs obtained from the BNF. Due to a lack of data on unit costs associated with private health care, the NHS equivalent was used to cost private health-care use. The 2015/2016 costs were inflated to 2019 prices using the consumer price index.

Health-related quality of life

Health-related quality of life was assessed using the five-level version of the EuroQoL-5D (EQ-5D-5L) questionnaire [19] in the baseline, 2-month and 6-month questionnaires. This measure comprises a descriptive system with five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). Each dimension is subdivided into five levels (no problems, slight problems, moderate problems, severe problems and extreme problems), resulting in the definition of 3125 separate states [19]. EQ-5D-5L index scores were generated using the cross-walk tariff as recommended by the National Institute for Health and Care Excellence (NICE) in the UK [20]. As a sensitivity analysis, EQ-5D-5L scores were also obtained with the UK value set [21–22].

Statistical analysis

Descriptive statistics were used to summarize the main health economic outcomes (health-care utilization and costs, and health-related quality of life). The initial description of healthcare utilization and costs was limited to complete cases. To ensure all eligible participants were included in the analysis and to overcome potential biased reporting due to missing data, missing EQ-5D-5L scores and costs were imputed using multiple imputation methodology [23]. A total cost-per-patient over a period of 6 months was estimated by summing up the costs associated with each health-care utilization item. Mean total costs associated with each patient risk subgroup were obtained, and bootstrapping (1000 replications) was used to estimate bias-corrected CIs around differences in mean costs and quality of life. Comparisons between risk subgroups used the low-risk subgroup as the reference category. Regression analysis was used to estimate costs in the patient risk subgroups and to investigate the relationship between the actual scores on the Keele STarT MSK Tool and costs. Mean costs by risk subgroup and by pain site were also estimated.

The study was approved by the South East Scotland Research Ethics Committee (14/SS/0083). All participants gave informed consent to take part.

Results

Of the 1890 participants, 193 (10.2%) participants did not have any risk subgroup classification due to missing items on the Keele STarT MSK Tool, and as a consequence they were not included in the analysis by risk subgroup. Overall (including participants without risk subgroup classification), most (51.5%) reported they had multi-site pain compared with pain in only one site (back 21.6%, knee 18.5%, shoulder 5.4%, neck 3.0%) (Table 1). A total of 1253 participants had complete resource-use and health-related quality of life data at 6 months, and of these 114 (9.1%) participants did not have a risk subgroup classification.

Health-care utilization and costs

Health-care utilization for cases with complete data is presented in Table 2 and Supplementary Table S1, available at *Rheumatology* online. The most common primary care visit was to the general practitioner (GP) (mean 1.44 visits per participant over 6 months). Across the subgroups, a higher proportion of participants in the high-risk subgroup (mean 2.22) reported GP consultations compared with those in the low-risk subgroup (mean 0.66). A similar trend was seen with secondary care consultations. The only exception was with respect to consultations to private acupuncturists and private physiotherapists, where slightly more of these types of consultations were reported by participants deemed to be at medium risk rather than high risk of persistent disabling pain (Table 2).

The results also showed that 36.9% of participants classified as being at high risk of persistent disabling pain reported treatments/investigations such as X-rays (NHS or private) over the 6-month follow-up period, compared with 29.5% and 14.5% in the medium- and low-risk subgroups, respectively (Table 2). The self-reported use of OTC medication ranged from an average of 40.7% in the low-risk subgroup to 52.4% and 51.6% in the medium- and high-risk subgroups, respectively. Regarding the type of prescribed medication, 23.9% and 15.1% of prescriptions in the low-risk subgroup were for NSAIDS and topical analgesics, compared with 10.7% and 7.8% in the high-risk subgroup, respectively. In contrast, only 8.4% of the prescriptions reported by participants in the low-risk subgroup were opioid medications, compared with 32.2% reported by participants in the high-risk subgroup (Table 2).

Data on health-care costs (complete cases and imputed analysis) are presented in Table 3 and Supplementary Figs S1 and S2, available at Rheumatology online. Overall, the mean total health-care (NHS and private) cost (s.D.) per participant recorded over the 6-months follow-up period was £306.17 (523.77). The total mean costs (s.D.) per participant over 6 months were £132.92 (167.88), £279.32 (462.98) and £476.07 (716.44) in the low-, medium- and high-risk subgroups, respectively, with total costs for both the mediumand high-risk subgroups being higher than those for the lowrisk subgroup. The regression analysis gave similar results (Table 3), and a similar pattern was seen across the five musculoskeletal pain sites. For example, for those presenting with back pain, total mean costs (S.D.) for the low, medium, and high-risk subgroups were £115.35 (136.22), £242.38 (291.21) and £389.66 (580.29), respectively. Similarly, for those presenting with multi-site pain, the total mean costs (S.D.) in the low, medium, and high-risk subgroups were £143.22 (173.16), £267.83 (352.95) and £503.38 (699.07), respectively. The results for the other pain sites are presented in Supplementary Table S2, available at Rheumatology online. The results from the regression analysis showed that there was no significant relationship between any cost items and the actual scores on the Keele STarT MSK Tool (Supplementary Table S3, available at *Rheumatology* online).

Health-related quality of life (EQ-5D-5L)

Data on health-related quality of life are presented in Table 4 and Supplementary Fig. S2, available at *Rheumatology* online. Overall, mean EQ-5D-5L scores increased over the 6-month follow-up, indicating improvement in general health-related quality of life. EQ-5D-5L scores in the highrisk subgroup were lower than those recorded in the low-risk subgroup at all time-points, with a mean score of 0.332 at baseline, compared with 0.621 and 0.778 in the medium-risk subgroup and low-risk subgroups, respectively. At 6 months, the mean EQ-5D-5L scores were 0.801, 0.655 and 0.420 in the low-, medium- and high-risk subgroups, respectively. A similar pattern was observed for the EQ-5D-5L scores that were obtained from the UK tariff (Table 4).

Work-related outcomes

Work related outcomes are presented in Table 2, and the results show that more participants in the high-risk subgroup (10.0%) had changed their usual employment due to pain at

Table 1. Baseline characteristics of participants with musculoskeletal pain in the KAPS cohort study

		Keele STarT MSK risk subgroup		
	Overall ^a	Low risk ^b	Medium risk ^b	High risk ^b
Pain site				
Back	408 (21.6%)	104 (24.6%)	147 (20.8%)	113 (19.9%)
Neck	57 (3.0%)	21 (5.0%)	29 (4.1%)	5 (0.88%)
Shoulder	103 (5.4%)	49 (11.6%)	40 (5.7%)	10 (1.8%)
Knee	349 (18.5%)	120 (28.4%)	137 (19.3%)	64 (11.3%)
Multi-site ^c	973 (51.5%)	128 (30.3%)	355 (50.1%)	375 (66.1%)
Participants who took time off work in	318 (16.8%)	56 (13.3%)	137 (19.4%)	105 (18.5%)
last 6 months for their pain				

^a The number in the overall column includes the 193 participants without a Keele STarT MSK tool subgroup classification.

^b This analysis excludes the 193 participants without a Keele STarT MSK risk classification.

^c Individuals could report pain at more than one pain site.

Table 2. Health-care utilization: mean visits (s.p.) over 6 months (complete cases)

			Keele STarT MSK risk subgroup			
		Overall $(n = 1253)^a$	Low $(n = 298)^{b}$	Medium $(n = 491)^{\mathrm{b}}$	High $(n = 350)^{b}$	
Primary care health-care utilization						
GP consultations	Practice	1.44 (2.191)	0.66 (0.959)	1.40 (2.154)	2.22 (2.738)	
	Home	0.12 (0.862)	0.04 (0.249)	0.07 (0.363)	0.18 (0.821)	
Nurse consultations	Practice	0.19 (0.774)	0.08 (0.348)	0.18 (0.777)	0.29 (1.029)	
	Home	0.05 (0.578)	0.04 (0.695)	0.05 (0.662)	0.06 (0.400)	
Other primary care consultations ^c	Practice	1.06 (2.823)	0.53 (1.500)	1.28 (3.227)	1.27 (3.186)	
	Home	0.10 (0.951)	0.01 (0.141)	0.13(1.295)	0.14 (0.841)	
Secondary care health-care utilization						
Consultant ^d	NHS	0.44 (1.349)	0.17 (0.505)	0.42 (1.196)	0.75 (1.982)	
	Private	0.21 (1.010)	0.11 (0.737)	0.26 (1.038)	0.26 (1.234)	
Physiotherapist	NHS	0.51 (1.667)	0.34 (1.191)	0.50 (1.542)	0.77 (2.238)	
, I	Private	0.33 (1.519)	0.20 (1.094)	0.41 (1.531)	0.39 (1.900)	
Acupuncture	NHS	0.08 (0.917)	0.03 (0.337)	0.10 (0.337)	0.11 (1.436)	
1	Private	0.07 (0.596)	0.06 (0.562)	0.10 (0.706)	0.10 (0.553)	
Osteopath	NHS	0.01 (0.135)	0.01 (0.116)	0	0.02 (0.232)	
1	Private	0.04 (0.536)	0.02(0.173)	0.03 (0.241)	0.09 (0.953)	
Other secondary care health-care utilization	ation and OTC me	dication n (%)	· · · /	х <i>Г</i>	()	
Overnight stay in hospital		43 (3.4%)	2(0.7%)	19 (3.9%)	21 (6.0%)	
Treatments or investigations		345 (28%)	43 (14.5%)	144 (29.5%)	129 (36.9%)	
OTC medication		608 (49%)	121 (40.7%)	256 (52.4%)	180 (51.6%)	
Prescribed medication $n(\%)^{e}$		× 7	· · · · · · · · · · · · · · · · · · ·	· · · · · ·	· · · · ·	
Total number of prescriptions		7039	536	2125	3659	
Simple analgesic		865 (12.3%)	62 (11.6%)	309 (14.5%)	406 (11.1%)	
Topical analgesic		624 (8.9%)	81 (15.1%)	180 (8.5%)	285 (7.8%)	
Compound analgesic		1504 (21.4%)	130 (24.3%)	509 (23.9%)	697 (19.1%)	
NSAID ^f		1001 (14.2%)	128 (23.9%)	397 (18.7%)	391 (10.7%)	
Skeletal muscle relaxant		245 (3.5%)	12 (2.2%)	50 (2.4%)	173 (4.7%)	
Neuropathic pain medication		734 (10.4%)	21 (3.9%)	186 (8.8%)	483 (13.2%)	
Opioid medication		1818 (25.8%)	45 (8.4%)	411 (19.3%)	1177 (32.2%)	
CS injection		77 (1.1%)	20 (3.7%)	31 (1.5%)	19 (0.5%)	
Other treatments ^g		171 (2.43%)	37 (6.9%)	52 (2.5%)	28 (0.8%)	
Work-related items (complete cases) n ((%)	· · · ·	· · · ·		х ,	
Employed at baseline		445 (39.1%)	139 (46.6%)	210 (42.8%)	96 (27.4%)	
Employed at 6 months		431 (38.0%)	137 (46.1%)	200 (40.9%)	94 (26.9%)	
Not in usual job at 6 months as a result	of pain	71 (5.7%)	1 (0.3%)	28 (5.7%)	35 (10.0%)	
Not in usual job at 6 months but emplo	ved at baseline	, , , , , , , , , , , , , , , , , , ,	1 (0.7%)	19 (9%)	26 (27%)	
Employed and doing usual job		328 (28.9%)	127 (42.8%)	150 (30.7%)	51 (14.6%)	
Employed and on paid leave		9 (0.8%)	_	6 (1.2%)	3 (0.9%)	
Employed and working fewer hours		36 (3.2%)	5 (1.7%)	19 (3.9%)	12 (3.4%)	
Employed and doing lighter duties		27 (2.4%)	` _	13 (2.7%)	14 (4.0%	
Employed and on paid sick leave		15 (1.3%)	3 (1.0%)	8 (1.6%)	4 (1.2%)	
Employed and on unpaid sick leave		6 (0.5%)		2 (0.4%)	4 (1.2%)	
Very satisfied with employment at 6 mo	onths	133 (11.7%)	54 (18.2%)	56 (11.5%)	23 (6.6%)	

The number in the overall column includes the 114 participants with complete data who were without a Keele STarT MSK subgroup classification.

This analysis excludes the 114 participants with complete data who were without a Keele STarT MSK risk classification.

This includes visits to physiotherapists in primary care.

This includes visits to rheumatologists, podiatrists, chiropractors and surgeons in secondary care. Obtained from medical records, with numbers indicating the number of times each drug class was prescribed as opposed to the number of patients who used them. NSAID.

Includes other miscellaneous treatments. OTC: over-the-counter.

6 months compared with those in the medium- (5.7%) and low-risk (0.3%) subgroups, respectively. Job satisfaction was highest in the low-risk subgroup, with 18.2% reporting they were very satisfied with their jobs, compared with 11.5% and 6.6% in the medium- and high-risk subgroups, respectively.

Discussion

Summary of the main findings

This study described and compared health-care utilization and costs, work outcomes, and health- related quality of life in patients with musculoskeletal pain, classified into different risk subgroups as defined by the Keele STarT MSK Tool. The results showed that patients identified as being at high risk of persistent disabling musculoskeletal pain had more primary and secondary care consultations for their pain, and incurred greater health-care costs over 6 months, compared with those in the medium- and low-risk subgroups. The mean total health-care (NHS and private) cost for all patients over 6 months was £306.17. By risk subgroup, the mean costs were £132.92 for the low-risk subgroup, £279.32 for the medium-risk subgroup and £476.07 for the high-risk subgroup. Patients in the medium- and high-risk subgroups had lower quality-of-life scores, compared with those in the low-risk subgroup, and the EQ-5D-5L scores at 6 months were 0.801, 0.655 and 0.420 for the low-, medium- and high-risk subgroups, respectively. The results also showed that more patients classified as being at high risk of persistent disabling musculoskeletal pain

Table 3. Health-care resource costs (£): mean (s.p.) over 6 months

	Overall $(n = 1253)^{a}$	Keele STa	Keele STarT MSK risk subgroup classification (complete cases)		
		$Low (n = 298)^{b}$	Medium $(n = 491)^{b}$	High $(n = 350)^{b}$	
Primary care health-care utiliza	ation				
GP visits ^c	34.75 (87.64)	21.56 (30.43)	29.49 (38.52)	45.45 (82.05)	
Nurse visits ^c	9.51 (40.07)	5.00 (35.20)	9.56 (43.05)	13.84 (43.15)	
Other primary care visits ^d	39.99 (96.15)	22.27 (59.26)	46.57 (102.02)	49.16 (116.07)	
Secondary care health-care util	ization	(, , , , , , , , , , , , , , , , , , ,		× ,	
Consultant ^{e,f}	37.79 (87.49)	17.19 (48.96)	39.32 (88.28)	56.24 (111.04)	
Physiotherapist ^f	30.84 (80.84)	19.66 (57.27)	33.04 (76.10)	42.20 (106.65)	
Acupuncture ^f	5.37 (39.63)	3.30 (23.74)	7.19 (37.90)	6.24 (55.82)	
Osteopath ^f	1.82 (20.08)	0.86 (7.56)	1.11 (8.78)	4.06 (35.62)	
Other secondary care health-ca	are utilization and medication	(prescribed and OTC)	× ,	× 7	
Investigations	82.02 (433.25)	20.77 (75.57)	71.62 (395.29)	155.92 (654.32)	
Prescribed medication	53.47 (174.76)	12.75 (62.46)	37.09 (107.87)	105.69 (247.82)	
OTC medication ^k	7.71 (28.15)	4.12 (14.30)	6.89 (23.70)	11.57 (37.39)	
Total cost	303.94 (591.56)	127.49 (184.52)	281.88 (519.58)	490.35 (832.79)	
Total NHS costs	272.33 (565.29)	111.27 (169.03)	245.03 (476.13)	449.73 (811.60)	
Total private costs	31.62 (93.26)	16.22 (52.55)	36.75 (94.07)	40.62 (122.41)	
Total costs (imputed analysis)		(, , , , , , , , , , , , , , , , , , ,			
	$n = 1890^{h}$	$n = 422^{i}$	$n = 708^{i}$	$n = 567^{i}$	
Total cost (imputed)	306.17 (523.77)	132.92 (167.88)	279.32 (462.98)	476.07 (716.44)	
Difference ^g (95% CI)		(,	146.40 (114.44, 191.42)	343.15 (285.93, 414.32)	
Total costs controlling for gen	der (imputed analysis)				
0 0		$n = 422^{i}$	$n = 708^{i}$	$n = 567^{i}$	
Total cost mean (s.e.) ^j		133.13 (25.24)	279.31 (19.46)	475.93 (21.76)	
Difference ^g (95% CI)			146.19 (83.72, 208.66)	342.81 (277.43, 408.19)	

The number in the overall column includes the 114 participants with complete data who were without a Keele STarT MSK classification.

This analysis excludes the 114 participants with complete data who were without a Keele STarT MSK risk classification.

Includes costs of both practice and home visits.

This includes visits to physiotherapists etc. in primary care.

This includes visits to rheumatologists, podiatrists, chiropractors and surgeons in secondary care. Includes costs of both NHS and private visits.

Using the low-risk subgroup as a reference.

The number in the overall column includes the 193 participants without a Keele STarT MSK classification.

This analysis excludes the 193 participants without a Keele STarT MSK risk classification.

Total cost derived from regression analysis controlling for gender.

OTC: over the counter; NHS: National Health Service.

Table 4. Health-related quality of life as assessed by the EQ-5D-5L (imputed analysis)

		Overall $(n = 1890)^a$	Low risk $(n = 422)^{b}$	Medium risk $(n = 708)^{b}$	High risk $(n = 567)^{b}$
EQ-5D-5L	Baseline	0.560 (0.266)	0.778 (0.109)	0.621 (0.178)	0.332 (0.263)
	Difference ^c (95% CI)			-0.157 (-0.172, -0.139)	-0.446 (-0.469, -0.421)
	2 months	0.600 (0.249)	0.788 (0.128)	0.656 (0.172)	0.396 (0.253)
	Difference ^c (95% CI)			-0.132 (-0.150, -0.114)	-0.392(-0.418, -0.369)
	6 months	0.611 (0.253)	0.801 (0.139)	0.655 (0.183)	0.420 (0.259)
	Difference ^c (95% CI)			-0.146 (-0.164, -0.126)	-0.381 (-0.408, -0.355)
EQ-5D-5L wi	th UK tariff				
-		Overall $(n = 1890)^a$	Low risk $(n = 422)^{b}$	Medium risk $(n = 708)^{b}$	High risk $(n = 567)^{b}$
EQ-5D-5L	Baseline	0.669 (0.260)	0.874 (0.087)	0.735 (0.170)	0.439 (0.264)
	Difference ^c (95% CI)			-0.139 (-0.153, -0.123)	-0.435 (-0.459, -0.410)
	2 months	0.699 (0.246)	0.878 (0.092)	0.763 (0.162)	0.496 (0.265)
	Difference ^c (95% CI)			-0.115 (-0.129, -0.099)	-0.382 (-0.409, -0.360)
	6 months	0.707 (0.247)	0.883 (0.108)	0.760 (0.174)	0.515 (0.270)
	Difference ^c (95% CI)			-0.123 (-0.138, -0.105)	-0.368 (-0.394, -0.345)

The number in the overall column includes the 193 participants without a Keele STarT MSK classification.

This analysis excludes the 193 participants without a Keele STarT MSK subgroup classification.

Using the low-risk subgroup as a reference.

changed their employment status over 6 months, compared with in the medium- and low-risk groups.

Stratified care studies such as the STarT Back trial have shown similar results, with health-care utilization generally being higher in the high-risk subgroup compared with in the

medium- and low-risk subgroups, and EQ-5D scores being lower in the high-risk subgroup [24]. Furthermore, baseline EQ-5D scores in the low-risk group in the STarT Back trial were twice as high as those in the high-risk subgroup, in line with the results of this study.

Strengths and limitations

The strengths of this study include the way in which we have provided a comprehensive health economics assessment (healthcare utilization and costs, work outcomes, and health-related quality of life) using the Keele STarT MSK Tool within a large prospective cohort of adults consulting with musculoskeletal pain in UK primary care. The design and methods for the cohort study and the health economic analyses were published in full previously in a protocol [15]. A limitation was that we could not compute the STarT MSK risk subgroup classification for some patients due to missing items (although this only related to 10.2% of the sample). In addition, the sample was limited to 1890 of the 4720 patients who were invited, which could lead to bias if the sample were systematically different from the whole group who were invited to participate. Finally, data for number of days off work were not collected, and as a result it was not possible to estimate productivity costs or time off work.

Implications for research and practice

The results of this study showed that health-care utilization and costs appear to be higher in those in the high-risk subgroup compared with the low- and medium-risk groups, and highrisk patients also experience lower health-related quality of life. These findings add to those of our previous paper [14], which showed the STarT MSK Tool identified those at risk of a poorer outcome, by also now showing that the tool also identified those who used more health-care and incurred higher costs. The study also provides valuable information about this patient group with whom comparisons can be made in intervention studies in the future. Furthermore, the findings provide an insight into the potential resource use and cost implications associated with each risk subgroup, which is potentially important information for health-care decision-makers when considering the impact of treatment options.

Conclusion

This study provides a clear description and comparison of the health economic outcomes (health-care utilization and costs, work outcomes, and health-related quality of life) in different levels-of-risk subgroups of primary-care patients with musculoskeletal pain, as defined and classified by the Keele STarT MSK Tool. The results provide useful information on the potential cost implications of successful interventions within each group.

Supplementary data

Supplementary data are available at Rheumatology online.

Data availability statement

The datasets analysed during the current study are available from the corresponding author on reasonable request.

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