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Original article

The Örebro Musculoskeletal Screening Questionnaire: Validation of a modified primary care musculoskeletal screening tool in an acute work injured population

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ABSTRACT

The original Örebro Musculoskeletal Pain Questionnaire (original-ÖMPQ) was developed to identify patients at risk of developing persistent back pain problems and is also advocated for musculoskeletal work injured populations. It is critiqued for its informal non-clinimetric development process and narrow focus. A modified version, the Örebro Musculoskeletal Screening Questionnaire (ÖMSQ), evolved and progressed the original-ÖMPQ to broaden application and improve practicality. This study evaluated and validated the ÖMSQ clinimetric characteristics and predictive ability through a single-stage prospective observational cohort of 143 acute musculoskeletal injured workers from ten Australian physiotherapy clinics. Baseline-ÖMSQ scores were concurrently recorded with functional status and problem severity outcomes, then compared at six months along with absenteeism, costs and recovery time to 80% of pre-injury functional status. The ÖMSQ demonstrated face and content validity with high reliability ($ICC_{2,1} = 0.978$, $p < 0.001$). The score range was broad (40–174 ÖMSQ-points) with normalised distribution. Factor analysis revealed a six-factor model with internal consistency $\alpha = 0.82$ (construct range $\alpha = 0.26$–0.83). Practical characteristics included completion and scoring times (7.5 min), missing responses (5.6%) and Flesch–Kincaid readability (sixth-grade and 70% reading-ease). Predictive ability ÖMSQ-points cut-off scores were: 114 for absenteeism, functional impairment, problem severity and high cost; 83 for no-absenteeism; and 95 for low cost. Baseline-ÖMSQ scores correlated strongly with recovery time to 80% functional status ($r = 0.73$, $p < 0.01$). The ÖMSQ was validated prospectively in an acute work-injured musculoskeletal population. The ÖMSQ cut-off scores retain the predictive capacity intent of the original-ÖMPQ and provide clinicians and insurers with identification of patients with potentially high and low risks of unfavourable outcomes.

1. Introduction

The early identification of patients at risk of developing disability from chronic musculoskeletal conditions is essential (Melloh et al., 2012). Despite the small percentage of injuries that transition from acute to chronic (Melloh et al., 2011), this subgroup accounts for the majority of financial (Driessen et al., 2008), individual and societal costs (Ekman et al., 2005). This subgroup is generally identified through their subjective history and the clinicians' experience and expertise (Bell and Burnett, 2009). However, the human judgement process can be flawed, particularly in identifying fear-avoidance (Calley et al., 2010), catastrophizing (Sullivan et al., 2011) and disability (Maher and Grotle, 2009). Screening questionnaires can supplement this judgement process, particularly for musculoskeletal conditions (Liebenson and Yeomans, 2007). The 'Örebro Musculoskeletal *Screening* Questionnaire' (*ÖMSQ*) (Gabel et al., 2011) is a recently developed instrument designed for this purpose and is a modified version of the original Örebro Musculoskeletal Pain Questionnaire (original-ÖMPQ) (Linton, 1999).

The original-ÖMPQ was developed to identify patients at risk of persistent pain. It is widely used and adapted from the Acute Low Back Pain Screening Questionnaire (ALBPSQ) (Linton and Hallden, 1998). It is advocated in clinical guidelines (van Tulder et al., 2006) and workers compensation guidelines (ACC-New Zealand, 2004; Workers Compensation Authority NSW, 2006; WorkCover SA, 2007; WorkSafe-TAC Victoria, 2007). Two systematic reviews of the original-ÖMPQ (Hockings et al., 2008; Sattelmayer et al.,

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2011) raised several critiques. These included the informal non-clinimetric development process and the use of total cut-off scores. Additional concerns have included the face and content validity, and that general musculoskeletal injuries and non-working individuals are not specifically included (Hurley et al., 2000; Margison and French, 2007). Consequently, to address these concerns the original-ÖMPQ was modified and progressed through rigorous clinimetric methodology to broaden its application and improve both practicality and suitability, resulting in the *ÖMSQ*.

The *ÖMSQ* incorporated the original-ÖMPQ's 'generalised musculoskeletal' application and 'screening' objectives and retained the item format, score range, and concept of cut-off score recommendations (Brown, 2008; Johnston, 2009). Simultaneously, the *ÖMSQ* simplified the questions, improved the psychometric characteristics (factor structure, face and content validity), practical characteristics (33% reduction in missing responses), and predictive ability. This revised instrument broadened the focus to general musculoskeletal problems, rather than the original emphasis on 'back', 'pain' and 'work' (Gabel et al., 2011). To continue this development the aims of this study were to: examine the *ÖMSQ* format for an acute musculoskeletal work-injured population; and further develop the clinimetric properties and predictive validity for the outcomes of function, problem severity, absenteeism, insurer costs and recovery time at six months.

2. Material and methods

2.1. Study design

A single phase prospective, observational cohort study was conducted in an independent work-related musculoskeletal injury population (Fig. 1).

2.2. Patients and setting

An inception cohort ($n = 143$, 42.6% female, age 38.9 ± 10.5, range 18–65 years) was formed from consecutive outpatients, recruited from a convenience sample referred by medical practitioners' to 10 Australian physiotherapy centres. Each referrer was interviewed where study goals and protocols were discussed. This facilitated referrals and minimised potential confounding through non-referral of suitable participants. The affected body areas included the back (50%), neck (16%), upper limbs (22%) and lower limbs (12%) with 5% of participants being multi-area injury. This was proportionally representative of the work-related injury population in the sampled geographical region (WorkCover Queensland, 2005). All participants were entitled to wage related compensation under the governing legislation. Consistency in entitlement was anticipated to minimise any confounding influence of financial compensation on individual recovery. The sample size required for each subgroup was estimated using the primary variable of the score and calculated from the original *ÖMSQ* LBP validation study (Gabel et al., 2011) with an 80% chance of detecting difference between baseline and repeated measures ($p < 0.05$) and allowing an additional 15% attrition. This gave sample estimates for test-retest reliability of $n > 42$, for predictive validity of $n > 126$, and for factor analysis of $n > 120$ (Field, 2005).

2.3. Inclusion and exclusion criteria

Participants included in the study had an acute musculoskeletal injury to the spine, upper limb or lower limb, sustained at work within the previous five weeks (NHMRC, 2003). The 'date of injury' was defined as the date the current injury commenced and included 'provocation or worsening of a pre-existing injury'. This classification accounted for 20% ($n = 29$) of participants. Exclusion criteria were pregnancy, red flags for serious spinal pathology, difficulty with English comprehension and <18 years. No upper age limit was specified in order to comply with equal opportunity and discrimination laws and maximise full workforce representation. The insurer outcome data were provided independently and the outcome assessors were blinded to the baseline *ÖMSQ* scores. All results were compiled at the study's completion. This facilitated the blinding process as the time between screening and compilation of the outcome results was maximized and compliant with recent methodology recommendations (Hockings et al., 2008).

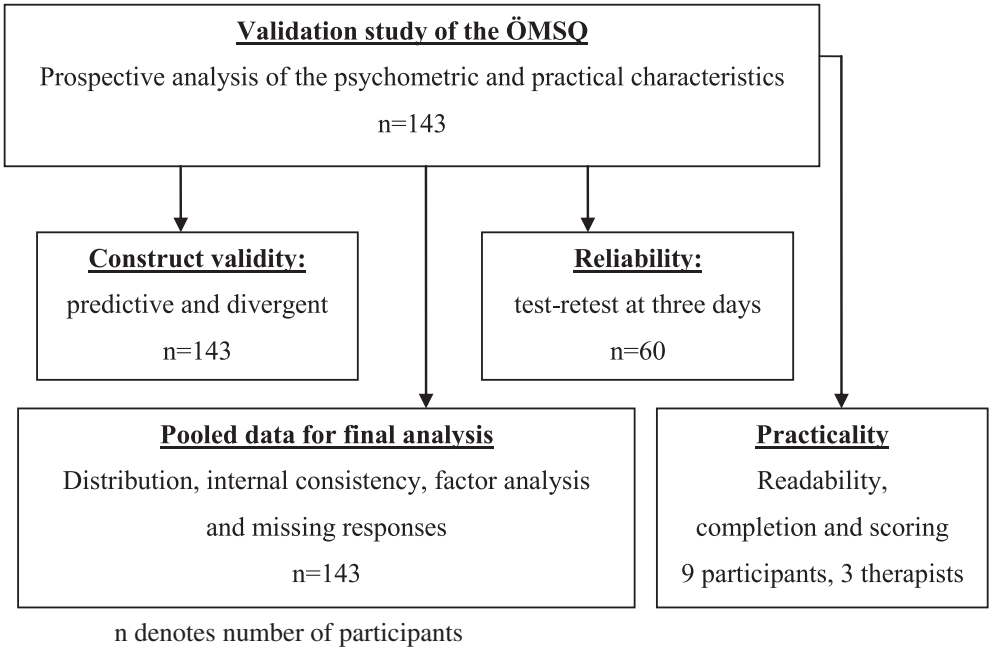

Fig. 1. Flow chart of *ÖMSQ* testing process in a general working musculoskeletal population.

Örebro Musculoskeletal Screening Questionnaire (ÖMSQ)

NAME:_____ Date:_____

Date of Birth:_____ Date of Injury:_____ Date Stopped Work or Routine:_____

☐ Male ☐ Female Problem and Area: _____

For your pain or problem, answer each question in a way that is suitable for you.

1. Where do you have your pain or problem? Use a tick (✓) for each site. *[2 x Count]*

☐ neck / back ☐ arm ☐ leg ☐ both sides ☐ several body areas

2. How many days of work or daily routine have you missed because of this? Check (✓) one.

☐ 0 days [1] ☐ 1-2 days [2] ☐ 3-7 days [3] ☐ 8-14 days [4] ☐ 15-28 days [5]
☐ 1 month [6] ☐ 2 months [7] ☐ 3-6 months [8] ☐ 6-12 months [9] ☐ over 1 year [10]

3. When did your current pain or problem start? Check (✓) one.

☐ 0 days [1] ☐ 1-2 days [2] ☐ 3-7 days [3] ☐ 8-14 days [4] ☐ 15-28 days [5]
☐ 1 month [6] ☐ 2 months [7] ☐ 3-6 months [8] ☐ 6-12 months [9] ☐ over 1 year [10]

4. Rate how much of a burden it is to perform all the things you need to do in a normal day.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Extremely*

5. For the last 2-3 days, rate on average how bothersome your pain or problem is.

0 1 2 3 4 5 6 7 8 9 10
No pain or/problem *Worst possible*

6. Over the last 2-3 months, rate on average how bothersome your pain or problem is.

0 1 2 3 4 5 6 7 8 9 10
No pain or problem *Worst possible*

7. For the last 2-3 days, for what percentage of the day do you notice your pain or problem?

0 10 20 30 40 50 60 70 80 90 100
Never *All the time*

We also need a bit more information on your thoughts and feelings.

8. During the past 2-3 days, rate how you cope or deal with your pain or problem. *[10-x]*

0 1 2 3 4 5 6 7 8 9 10
Not at all *Extremely well*

9. During the past 2-3 days, rate how tense or anxious you have felt.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Extremely*

10. During the past 2-3 days, rate how "depressed" or "down" you have felt.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Extremely*

Fig. 2. Örebro Musculoskeletal Screening Questionnaire (*ÖMSQ*).

We also need a bit more information on your thoughts and feelings.

11. What do you think is the risk that your current pain or problem will not improve.

0 1 2 3 4 5 6 7 8 9 10
No risk *Very large risk*

12. What's the chance you'll be working or doing your normal routine in 6 months? *[10-x]*

0 1 2 3 4 5 6 7 8 9 10
No chance *Very large chance*

13. Think of your life; rate how satisfied you are with your current situation. *[10-x]*

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely*

How true are the next three statements?

14. Physical activity makes my pain or problem worse.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely*

15. If my pain or problem increases, I should stop what I am doing.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely*

16. I should not do my normal daily routine or work with my present pain or problem.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely*

Help us to better understand your current physical abilities. *[10-x]*

17. I can do light work for an hour such as lifting, carrying or moving objects <5kg or 10lb.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely normal*

18. I can walk for an hour or participate in my normal light recreational or sporting activities.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely normal*

19. I do my normal home activities and chores (steps, chairs, cleaning, family, duties…).

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely normal*

20. I do my normal daily routine and social activities (shopping, transport, see friends…).

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely normal*

21. I can sleep at night and move normally in bed.

0 1 2 3 4 5 6 7 8 9 10
Not at all *Completely normal*

Therapists Notes: Questions score 0-10; Qs 8, 12-13, 17-21 reverse (**10-x**); Q 1 is **2x**

Scores: **1=____ 2 to 7=____ 9 to 11=____ 14 to 16=____ 8,12 & 13=____ 17 to 21=____**

TOTAL=_____

Fig. 2. *(Continued)*

2.4. Assessments

Measurement and data collection were performed by self-report questionnaires that included the *ÖMSQ* and patient reported outcomes (PROs) for functional impairment and problem severity. These PROs were completed at baseline then repeated at two-week then four-week intervals until discharge or study completion at six months. Absenteeism and cost data were provided by the participants' insurer. Predictive ability was estimated from dichotomized patient responses of 'less affected' and 'more affected' (Field, 2005) for six specific outcome traits.

1. *Functional status* was assessed by region specific PROs with continuity of format and scale. This enabled direct comparison and pooling of PRO scores: the Spine Functional Index (Gabel et al., submitted for publication), the Upper Limb Functional Index (Gabel et al., 2010) and the Lower Limb Functional Index (Gabel et al., 2012). Each questionnaire had 25, three-point scale questions with a minimal detectable change <8%. Status was divided into 'recovered' at ≤10% or 'non-recovered' at >10% (Ostelo et al., 2008).
2. *Problem severity* was assessed from an eleven-point global numerical rating scale (NRS-global) where 0 = No problem and 10 = Maximum (Farrar, 2000) with a >10% cut-off for 'non-recovered'.
3. *Absenteeism* was assessed by 'paid-days-off' (PDO) recorded by the participants' insurer and divided into PDO = 0 (none) versus PDO > 0 (absenteeism).
4. *Long term absenteeism* was assessed by a cut-off of PDO > 28 (Australia's longest permitted continuous work period) (AIRC, 1999).
5. *Total cost* was assessed in Australian dollars from insurer incurred expenses. This included all consultations, treatments, investigations, wages and travel as calculated from the date of original injury. For 20% of participants this was different from their date of provocation or exacerbation. This cost was dichotomized into high-cost ≥$10,000 and low-cost <$1000. The interim group was not evaluated to minimise the effect of those with exacerbation, 85% of who were classified within the high-cost group and the remainder who were within the interim group.
6. *Recovery time* was the number of days required to reach 80% recovery on the PRO measure (t^{80}) (Gabel et al., 2006). This functional status was lower than the 'recovered' classification of 10%, but was selected to maximise statistical correlation (Gabel et al., 2011) and allow for symptom fluctuation within a chronic state (Young et al., 2011). This 80% level was defined as a PRO score ≤20% (Ostelo et al., 2008). An *a-priori* minimum correlation was required with the *ÖMSQ* baseline score of $r > 0.70$ ($p < 0.01$) (Field, 2005).

Sensitivity and specificity were calculated at the different *ÖMSQ* cut-off scores to determine the optimum threshold for each outcome. The subsequent positive likelihood ratios (LRs) were determined from: sensitivity/(1−specificity). Negative LRs were not calculated as only cut-off scores for trait presence were required.

2.5. Face and content validity

Two focus groups provided feedback and determined the *ÖMSQ's* face and content validity. A 12-person participants group that contained four sets of three participants with symptoms from the same region, the back, neck, upper limb and lower limb; and a three-person therapists group. A two thirds majority consensus opinion was required (nine participants and two therapists). The recommended changes (detailed in the results) were implemented (Fig. 2).

2.6. Psychometric characteristics

To determine the psychometric characteristics, validity and reliability sub-groups were used. The full data sample was used for all remaining characteristics (Fig. 1).

Construct validity ($n = 143$): criterion-related validity as demonstrated by predictive validity calculated from the positive LRs; divergent validity as demonstrated by a statistically significant *t*-test comparing *ÖMSQ* scores between groups with known positive and negative traits for each outcome excluding '*Recovery time*';

Test–retest reliability ($n = 60$): used the $ICC_{2,1}$ at three days (Shrout and Fleiss, 1979). Proportional representation by body region reflected the general compensation population (WorkCover-Queensland, 2005) for the back ($n = 24$), neck, upper limb and lower limb ($n = 12$ for each).

2.7. Practical characteristics

The original development study methodology was employed to determine *missing responses, completion time and scoring time*. The *readability* was determined from the Flesch–Kincaid scales of 'Reading Grade' and 'Flesch Reading Ease' as calculated through word-processing software (Kincaid et al., 1975; Paasche-Orlow et al., 2003).

2.8. Statistical analysis

The SPSS version 14.0 (Inc, Chicago, IL) was used with significance level set at $p < 0.01$. Factor analysis used maximum likelihood extraction with varimax rotation and coefficient suppression at 0.30 (Costello and Osborne, 2005).

3. Results

3.1. Focus group

The focus group consensus supported *face and content validity*. Recommendations to improve the *ÖMSQ* format to facilitate acceptance and use in the clinical and research settings included: simplifying the boxed format; shortening the introduction; use of single-line summary statements for introductory sentences; clarification of scale range through modification of descriptive anchors for minimums and maximums; substitute 'days' for 'weeks'; and minor wording changes to improve clarity for questions 4, 11 and 13 (Fig. 2).

3.2. Psychometric characteristics

The *ÖMSQ baseline responses* are provided in Table 1. Normality for these scores was examined through a normalised histogram, Shapiro–Wilk test (0.987,df = 143, significance < 0.190), and examination of Skewness and Kurtosis. These indicated *ÖMSQ baseline scores* were distributed normally. *Test–retest reliability* was high ($r = 0.978$, $p < 0.001$) and comparable for each body region where respective *r* values were: full spine = 0.967, back = 0.954, neck = 0.981, both limbs = 0.978, upper limb = 0.942 and lower limb = 0.984.

Predictive validity using the full sample of $n = 143$ was shown through positive LRs (Table 2). The critical cut-off score was 114 *ÖMSQ*-points for absenteeism, long term absenteeism, functional impairment, severity and high cost. Other cut-offs were 83 *ÖMSQ*-points for 'no absenteeism' and 95 *ÖMSQ*-points for low cost. At three months, the transition from subacute to chronic, 15.4% of participants were 'non-recovered' (spine = 13.4%, cervical = 19.9% and back = 11.7%;

Table 1
Baseline ÖMSQ responses in a musculoskeletal working population.

Qu	Response format	Construct by factor (#)	Variable name	*n* (%)	Mean (SD)	Missing items
1	Categories	Other (5)	Region			
			Back	77 (54%)		
			Neck	23 (17%)		
			Arm	35 (24%)		
			Leg	22 (12%)		
			Both sides	31 (22%)		
			Several areas	30 (21%)		
2	Categories	Personal (4)	Absenteeism			1
			0 days	3 (2%)		
			1–28 days	103 (72%)		
			>28 days	37 (26%)		
3	0–10	Personal (4)	Duration		4.1 (2.9)	
4	0–10	Other (5)	Burdensome		5.5 (2.9)	
5	0–10	Other (5)	Intensity acute		6.3 (2.0)	
6	0–10	Problem (3)	Severity chronic		6.0 (2.9)	2
7	0–10	Problem (3)	Frequency		6.3 (3.2)	4
8	0–10	Psyche (2)	Coping		4.8 (2.2)	
9	0–10	Psyche (2)	Anxiety		5.8 (2.9)	
10	0–10	Psyche (2)	Depression		4.5 (3.3)	
11	0–10	Psyche (2)	Recovery expectation problem		5.2 (2.9)	1
12	0–10	Personal (4)	Recovery expectation work		1.6 (2.5)	
13	0–10	Physical (1)	Job satisfaction		3.7 (3.0)	1
14	0–10	Physical (1)	Fear-avoidance: activity		7.4 (2.4)	
15	0–10	Fear-avoidance (6)	Fear-avoidance: stop		8.0 (2.5)	
16	0–10	Fear-avoidance (6)	Fear-avoidance: not work		6.8 (3.2)	
17	0–10	Physical (1)	Light work/chores		5.2 (3.2)	
18	0–10	Physical (1)	Walk/recreation		4.8 (3.3)	1
19	0–10	Physical (1)	Home activity		4.6 (2.7)	
20	0–10	Physical (1)	ADL and social		5.1 (2.7)	
21	0–10	Physical (1)	Sleep/move in bed		5.1 (2.9)	
			Total score			10 or 7.0%
			Low risk ≤ 83	41 (29%)		
			Moderate risk 83–114	35 (24%)		
			High risk > 114	67 (47%)		

$n = 143$, ÖMSQ score range = 40–174 points, mean = 106.4 ± 29.0. The six constructs are identified by name and number. Continuous variables are presented as means with SD in parentheses and categorical variables as frequencies with percentages (%) in parentheses. Questions are rated 0–10 points where higher scores indicate increased risk. Questions 8, 12, 13 and 17–21 were reversed and calculated as (10 − score).

extremities = 16.9%, arm = 17.2%, leg = 16.7%). At six months 7.7% of participants were 'non-recovered' (spine = 8.2%, cervical = 6.6% and back = 8.8%; extremities = 7.3%, arm = 8.5%, leg = 5.9%).

Discriminant validity was demonstrated by significant *t*-tests between outcome/non-outcome groups (Table 3). This was supported by a high Pearson's correlation between the *ÖMSQ* and t^{80} ($r = 0.73$ $p < 0.01$). *Internal consistency* of the total score was good (Cronbach's $\alpha = 0.83$), although individual constructs varied ($\alpha = 0.26$–0.83, Table 4).

The *factor analysis* correlation matrix was determined as suitable from the Kaiser–Meyer–Oklin value of 0.73 and highly significant Barlett Test of Sphericity ($p < 0.001$). The *ÖMSQ* generated six factors based on the Scree plot (Cattell, 1966), eigenvalues >1.0 (Kaiser, 1960) and item-variance >5% (Field, 2005). The total cumulative variance was 63.6%. The rotated six-component solution showed consistent loading within the designated constructs (Table 4) with failure to load for two *ÖMSQ*-items (#1 and #12) and cross-loading for two items (#15 and #16).

Table 2
Predictive validity as determined from sensitivity and specificity cut-off scores.

Outcome	ÖMSQ cut-off	Sensitivity	Specificity	LRs
Absenteeism (>0 paid days off)	114	60.5%	92.3%	7.9
Long term absenteeism (≥28 paid days off)	114	78.3%	80.4%	4.0
Functional Status (not recovered >10%)	114	79.1%	69.0%	2.5
Problem severity (not recovered >10%)	114	79.1%	67.2%	2.4
High cost (≥$10,000)	114	85.3%	73.5%	3.2
No absenteeism (no days off)	83	53.8%	88.2%	4.5
Low cost (<$1000)	95	75.9%	76.6%	3.2
Risk categories	Low	Medium	High	
Absenteeism	<83	83–114	>114	
Cost	<95	95–114	>114	

Where: LR = Sensitivity/(1−Specificity).

3.3. Practical characteristics

Readability for the *ÖMSQ* was confirmed with 'Flesch Reading Ease' at 70% and 'Flesch–Kincaid grade' at 6.0. *Missing responses* were at 5.6% ($n = 10$ in eight questionnaires, Table 1). *Completion time* was 5.57 ± 3.03 min and scoring time 1.28 ± 0.10 min.

4. Discussion

4.1. Main findings

The *ÖMSQ* was validated in an independent acute musculoskeletal work injured population. The psychometric and practical characteristics were equivalent to those calibrated in the LBP population (Gabel et al., 2011). The predictive ability for outcome status at six months post-injury, as determined by the positive LRs, was comparable to the LBP population. This reinforced the development and validation study conclusions that the *ÖMSQ* may be substituted for the original-ÖMPQ. This study consequently provides the required research on the *ÖMSQ*, as a modification of the original-ÖMPQ, that has assessed and verified its applicability in a broader general musculoskeletal population.

The *ÖMSQ* score predicted important outcomes related to financial costs, an important consideration for insurers (Westman et al., 2008), and the time required to achieve 80% functional status, an important consideration for predicting recovery (Young et al., 2011). The optimal *ÖMSQ* cut-off score was 114 *ÖMSQ*-points with sensitivity levels around 80%. This cut-off score was comparable to the 110 *ÖMSQ*-points determined for LBP (Gabel et al., 2011) and 109 *ÖMSQ*-points for whiplash (Gabel et al., 2008). It marginally exceeded the 105–112 ÖMPQ-points cut-off range found in several LBP studies (Linton and Hallden, 1998; Grotle et al., 2007) but was markedly higher than the 90 ÖMPQ-points from the Swedish spinal study (Linton and Boersma, 2003), 81 ÖMPQ-points from the Dutch LBP study (Heneweer et al., 2007) and 72 ÖMPQ-points from the Dutch neck study (Vos et al., 2009).

Table 3
Independent *t*-tests between outcome groups of known difference ($n = 143$).

Group defined by	Positive trait ÖMSQ score mean 95% CI		Negative trait ÖMSQ score mean 95% CI		*t*-Statistic[a]
Absenteeism (>0 PDO)	116.2	114–18.4	84.8	82.8–86.8	5.40
Long term (≥28 PDO) absenteeism	126.4	124.7–128.1	93.3	91.1–95.5	6.96
Function (≥10%)	128	126.2–129.8	95.6	93.4–97.8	6.48
Severity (≥10%)	130.2	128.6–131.8	95.8	93.5–98.1	6.90
Cost (≥$10,000)	126.9	125.1–128.7	98.8	96.5–101.1	5.17

[a] All tests were significant ($p < 0.001$).

However, it is lower than the 119–141 found in three musculoskeletal studies (Dunstan et al., 2005; Margison and French, 2007; Westman et al., 2008). The established 109–114 *ÖMSQ*-points cut-off range is midway between these original-ÖMPQ spine and generalised populations findings. This supports the use of the *ÖMSQ* as an evolved version of the original-ÖMPQ and demonstrates its improved consistency. These differences could be attributed both geographical and cultural differences in the patient population. However, they may also be a consequence of the improved relevance of the individual *ÖMSQ* questions. The scores may also be affected by 'therapist influences' such as treatment, management and practitioners that catastrophize for their patients.

The *ÖMSQ* language changes were developed and tested in Australia as a representative multicultural English-speaking society. Consequently they should improve patient responses and provide greater consistency between different population groups. This potential explanation was supported by patient focus group feedback and by the lower missing responses, 5.6%–6.6%, compared to the original-ÖMPQ at 11.8% (Gabel et al., 2011) or 16%–25% (Grotle et al., 2006).

The results reported similar chronicity levels for the different body regions. This implies that screening for long-term complications in both the extremities and the spine seem equally worthwhile. The *ÖMSQ* successfully identified a high proportion of 'non-recovered' at six months through both constructs and specific contributing items with higher means (Sattelmayer et al., 2011). These findings are consistent with previous original-ÖMPQ and ALBPSQ studies where fear avoidance and pain that is widespread, of a high level, or chronic, were prognostic for LBP at 12 months (Grotle et al., 2010). This acute/chronic timeline was also identified by Foster et al. (2010) who used the six month time frame to select patients for targeted treatments. Foster also included coping through perceived personal control and pain self-efficacy as determined in this study. By contrast, they found depression and fear avoidance as not significant. The *ÖMSQ* was specifically designed to broaden and evolve the original-ÖMPQ. This should increase its' suitability for general musculoskeletal populations including the spine. However, it cannot account for all identified potential risk factors such as illness (Foster et al., 2008), perceived injustice (Sullivan et al., 2008), catastrophizing (Sullivan et al., 2001), beliefs (Symonds et al., 1996) and expectations (Hilfiker et al., 2007).

4.2. Validation considerations

The prospective validation of a prognostic instrument is considered essential (Altman et al., 2009). To date, no published study has assessed the psychometric and practical characteristics of the original-ÖMPQ in an acute general musculoskeletal population, the defined target population for which it is advocated by clinical guidelines. These characteristics have only been investigated in LBP populations in four separate data sets (Linton and Hallden, 1998; Linton and Boersma, 2003; Grotle et al., 2005; Gabel et al., 2011). The *ÖMSQ* modification process broadened the application capacity to all body regions (Margison and French, 2007), anticipated those in non-working situations (Hurley et al., 2000) and would be eligible for consideration by guidelines committees. This process also addresses critiques concerning the development and validation methodology used to produce the ALBPSQ and subsequently the original-ÖMPQ.

4.3. Sample size considerations

Sample sizes for one of our primary statistical analyses, compared favourably with previous research. Only three original-ÖMPQ studies considered multiple body regions of the spine, upper and lower extremities. Only two had comparable sample sizes (to

Table 4
ÖMSQ factor analysis loading in a working musculoskeletal population.

	1 Physical function	2 Psychological	3 Problem	4 Personal	5 Other	6 Fear-avoidance
Q20 ADL and social	0.944					
Q18 Walk or light recreational activity	0.775					
Q21 Home activity	0.720					
Q17 Light work – 1 h	0.719					
Q19 Sleep or movement in bed	0.510					
Q14 Fear-avoidance: activity makes worse	0.426					
Q13 Job satisfaction	0.333					
Q10 Depression		0.843				
Q9 Anxiety		0.757				
Q11 Recovery expectation: of problem		0.470				
Q12 Recovery expectation: of work		<0.300				
Q1 Region		<0.300				
Q7 Problem severity – chronic			0.890			
Q6 Problem frequency			0.665			
Q3 Problem duration				0.807		
Q2 Absenteeism				0.729		
Q5 Problem intensity – acute					0.954	
Q4 Burdensome					0.392	
Q16 Fear-avoidance: stop work/ADL if worse	0.387					0.595
Q15 Fear-avoidance: stop if activity if worse			0.384			0.427
Q8 Cope with problem						0.415[a]
Internal consistency by construct α=	0.83	0.69	0.77	0.72	0.55	0.26
Total tool $\alpha = 0.82$						

Factor analysis used maximum likelihood extraction and varimax rotation; 21 items ($n = 143$), suppression at 0.300.
[a] Q8 loading has been reversed by multiplying by −1.

our $n = 143$) at both baseline and follow-up with $n = 211$ (Margison and French, 2007) and $n = 158$ (Westman et al., 2008). The third had $n = 55$ at final follow-up (Dunstan et al., 2005). Of the remaining 13 discrete data sets, where only LBP or spine with referral pain to the limbs was considered, six studies had comparable or larger sample sizes exceeding $n = 140$ (Appendix 1).

4.4. Psychometric properties

The high reliability ($r = 0.978$) in this study was comparable to the original-ÖMPQ ($r = 0.975$) and the *ÖMSQ* ($r = 0.982$) development study (Gabel et al., 2011). Consequently, wording modifications alone were unlikely to have improved reliability which was higher than previous original-ÖMPQ and ALBPSQ studies. A more likely explanation was this study's use of the recommended $ICC_{2.1}$ method with a three-day interval in the target acute patient population (Shrout and Fleiss, 1979). The four previous reliability studies found $r = 0.90$, $ICC_{1.1}$ at two days with chronic patients (Grotle et al., 2006), $r = 0.85$, $ICC_{2.1}$ at one week with acute patients (Vos et al., 2009), $r = 0.83$, Pearson's product-moment at one week in chronic patients (Linton and Hallden, 1998), and $r = 0.80$, Pearson's product-moment at 2–4 weeks in sub-acute to chronic patients (Linton and Boersma, 2003).

This study's demographic details were comparable with previous findings (Hockings et al., 2008) as were the baseline percentage of 'non-recovered' patients (Heneweer et al., 2007) and absenteeism levels (Grotle et al., 2007). However, those 'non-recovered' at six months (7.7%) were considerably lower than previously reported at 15%–70% and likely to be due to different definitions of 'non-recovered' and the outcome criteria used.

Factor analysis with maximum likelihood extraction showed a six-factor model aligned to the theoretical constructs (Linton and Hallden, 1998). Previous studies showed poorer fit to this proposed model, including less factors (Grotle et al., 2006), and items (Westman et al., 2008), specifically for 'Distress' and 'Fear-avoidance'. This may be attributed to principal component analysis, which is inappropriate for normally distributed populations (Fabrigar et al., 1999), and use of chronic LBP participants (Westman et al., 2008). This study's six factors explained 63% of variance, an acceptable statistical level (Henson and Roberts, 2006). This was higher than the 49% reported by Grotle et al. (2006) but comparable to the 59.8% found by Heneweer (2010) and marginally lower than the 69% found by Westman et al. (2008) on 17 items. Our analysis showed some support for a four construct model which suggests a shorter more practical tool, perhaps with 12-items, could be developed and investigated. This would facilitate early recognition of the critical underlying constructs that lead to delayed recovery. Such recognition can optimize referral to specific targeted interventions that facilitate improved outcomes (Foster et al., 2010).

4.5. Limitations

The findings cannot be extrapolated beyond the time frame of the six month follow-up. The study included participants with provocation or exacerbation of a previous injury. This was a confounding factor for cost calculations for the interim group and high-cost groups as it included participants with insurer calculated costs that were incurred prior to the study's defined date of inclusion. Entitlement to wage-related compensation may also be a potential confounder for individual recovery however its influence was beyond the scope of this study.

4.6. Strengths

The *ÖMSQ* sought to improve upon the original-ÖMPQ for use in a broader musculoskeletal population. It provided greater diversity in work status, body regions and symptoms. The *ÖMSQ* psychometric and practical characteristics were consistent with the original development study in an LBP population (Gabel et al., 2011). There was comparable reliability but at a value higher than reported in previous original-ÖMPQ studies.

4.7. Implications for practice

The *ÖMSQ* provided reference cut-off scores that supplement clinical judgement. These are conducive to everyday primary care as they complement and facilitate standard clinical examination. This includes a clinicians' decision to 'wait and see' or refer to specialists, psychologists, counsellors or rehabilitation. This referral decision could be assisted by total construct scores and individual profiles

determined by the response to specific questions and constructs (Sattelmayer et al., 2011). The determined cut-off scores could assist in minimising incorrect prognosis classification (Hill et al., 2010). This would enable at-risk patients to be identified and appropriately referred at an earlier stage. The *ÖMSQ* scores are interchangeable with the original-ÖMPQ due to the systematic modification process used in the *ÖMSQ* development. This is supported by the excellent criterion validity ($r = 0.97$) previously demonstrated (Gabel et al., 2011). These considerations should facilitate acceptance of the *ÖMSQ* in clinical, research and insurance settings which minimize potential data loss for existing systems that use the original-ÖMPQ.

4.8. Implications for research

Further research should seek to validate these findings in both general and specific subgroup populations, including the limbs, the elderly and sports injury populations. This may lead to a more accurate prediction of chronicity (Hockings et al., 2008) and individual recovery time (Gabel et al., 2006). Furthermore, systematic reviews of predictive validity (Hockings et al., 2008) and meta-analysis of screening and outcome scores, including individual profiles and item construct scores (Sattelmayer et al., 2011), should be extended from the original-ÖMPQ's spinal populations to general musculoskeletal populations. In addition, investigation of the effectiveness of specific interventions targeting screening questionnaire constructs should be considered. A shortened 12-item instrument could be considered in order to improve clinical practicality through reduced patient and clinician burden yet retain representation of the six constructs determined by the focus group and factor analysis. This concept is supported by a recent LBP version (Linton et al., 2011) and potential item redundancy shown through factor analysis and loading inconsistencies between the *ÖMSQ* and original-ÖMPQ.

5. Conclusions

The *ÖMSQ* is a valid and reliable instrument that can assist in identifying acute musculoskeletal work injured patients in a primary care setting that are at risk of unfavourable outcome at six months. This may facilitate early specialist referral and optimize outcomes from targeted intervention strategies.

Competing interests

None.

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Appendix 1

Comparison of data between *ÖMSQ* and previous original-ÖMPQ studies, modified ÖMPQ versions and the ALBPSQ.

Author	Journal	Questionnaire	Country	Patient type	Region	*n* at baseline	*n* at follow-up	Mean/Median	Score range	Cut-off
Linton and Hallden, 1998	Clin J Pain	ALBPSQ	Sweden	Acute–subacute	Spine and shoulders	147	137 (93.2%)	104	45–176	105
Kendall, 1999	IASP 9th Cong	ALBPSQ	New Zealand	Acute	LBP	Not stated	Not stated	Not stated	Not stated	105
Hurley et al., 2000	Clin J Pain	ALBPSQ	Northern Ireland	Acute	LBP	118	90 (76.3%)	Median 113.5	49–208	112
Hurley et al., 2001	Clin J Pain	ALBPSQ	Northern Ireland	1 year review	LBP	118	90 (76.3%)	Median 113.5	49–208	112
Linton and Boersma, 2003	Clin J Pain	ÖMPQ	Sweden	Acute–subacute	Spine and shoulder	122	107 (87.7%)	95	32–166	90
Dunstan et al., 2005	Int J Rehabil Res	Mod-ÖMPQ	Australia (NSW)	Chronic	General	196	55 (28.1%)	99.6	Not stated	119
Nordeman et al., 2006	Clin J Pain	ÖMPQ	Sweden	Subacute	LBP	60	53 (88.3%)	97.5	80–115	105
Grotle et al., 2005	Spine	ALBPSQ	Norway	1 year review	LBP	123	112 (91%)	Acute = 78.9 Chronic = 115	45–125	105
Grotle et al., 2006	Clin J Pain	ALBPSQ	Norway	Mixed	LBP	123	112 (91%)	Acute = 78.9 Chronic = 115	45–125	105
Grotle et al., 2007	Eur J P	ALBPSQ	Norway	1 year review	LBP	123	112 (91%)	Acute = 78.9 Chronic = 115	45–125	105
Margison and French, 2007	J Occup Environ Med	Mod-ÖMPQ	Canada	Chronic	General	211	211 (100%)	123/220	Not stated	147/220
Jellema et al., 2007	Br J Gen Pract	ÖMPQ	Holland	Acute–subacute	LBP	314	298 (94.9%)	Not stated	Not stated	Low = 90 High = 105
Heneweer et al., 2007	Spine	ÖMPQ	Holland	Acute–subacute	LBP	66	56 (84.8%)	Recovered = 67 Not = 81	41–106	81
Gabel et al., 2008	Int J Rehab Res	ÖMSQ	Australia (Qld)	Acute–subacute	WAD	33	30 (90%)	95	46–179	109
Grimmer-Somers et al., 2008	J Pain Res	ALBPSQ	New Zealand	Acute	LBP	328	328 (100%)	Not Stated	10–146	Low = 50, High > 105 Med = 50–89
Westman et al., 2008	Eur J Pain	Mod-ÖMPQ	Sweden	Chronic	General	158	149 (94.3%)	121	Not stated	>117 and <139
Hill et al., 2009	Eur J Pain	ÖMPQ	UK	Not stated	LBP	131	130 (99.2%)	Not noted	Not stated	Low = 90 High = 112

(*continued*)

Author	Journal	Questionnaire	Country	Patient type	Region	*n* at baseline	*n* at follow-up	Mean/Median	Score range	Cut-off
Vos et al., 2009	J Manip Physiol Ther	ALBPSQ	Holland	Acute–subacute	Neck	187	180 (96.3%)	71.3	14–151	72/200
Maher and Grotle, 2009	Clin J Pain	ÖMPQ	Norway /Australia (NSW)	Mixed	LBP	259	230 (88.9%)	75.2 and 84.6	Not stated	Not stated
Heneweer et al., 2010	Spine	ÖMPQ	Holland	Acute–subacute	LBP	66	56 (84.8%)	Recovered = 67	Not = 85	41–106
Gabel et al., 2011	Eur Spine J	ÖMSQ	Australia (Qld)	Acute–subacute	LBP	106	106 (100%)	112.5	40–174	110
This article	Man Ther	ÖMSQ	Australia (Qld)	Acute–subacute	General	143	143 (100%)	106.4	40–174	114

Appendix 2. Glossary of terms.

Barlett Test of Sphericity: preliminary test conducted to determine if three or more independent samples are homogenous or variant before proceeding.

Cronbachi's alpha coefficient: test for a model or survey's internal consistency.

Clinimetric properties: assessment or description of symptoms, signs and findings by means of scales, indices and other quantitative instruments – e.g. psychometric and practical characteristics of an outcome measure.

Concurrent validity: method of determining validity as the correlation of the test with scores from known valid measures. Pearson's Correlation Coefficient r value most commonly used

Construct validity: degree to which an instrument accurately measures the underlying theoretical or hypothetical constructs of concern including the normality of baseline. Distribution patterns, the presence of floor and ceiling effects and how well the tool performs in comparison to instruments of a similar (convergent validity) and/or dissimilar (divergent validity) purpose and dimension.

Content validity: method of establishing validity based on expert judgement that the content of the measure is consistent with what is to be measured.

Convergent validity: type of validity determined by hypothesizing and examining the overlap between two or more tests that presumably measure the same construct

Criterion validity: degree to which a measure or test correlates with other measures or tests of the same construct assessed concurrently or in future; ability of a test to predict a criterion.

Discriminant validity: degree to which an operation is not similar to or diverges from other operations that it theoretically should not be similar to.

Divergent validity: hypothesizing and examining differential relations between a test and measures of similar or different constructs; the ability of a scale to discriminate between patients with maximal and minimal functional deficits.

Effect size: mean change scores divided by the standard deviation of the baseline scores.

Eigenvalue: value such that a given square matrix minus that number times the identity matrix has a zero determinant. A cut-off value of 1.0 is often considered critical (in factor analysis).

Face/logical validity: overall appearance of the test; extent to which a test appeals to test takers.

Factor structure: mathematical procedure to reduce large amounts of data into a structure that can be more easily studied

Flesch-Kincaid scale: 'Reading Ease' and 'Grade Level' use word length and sentence length to indicate the comprehension difficulty when reading text, the scales are invesely related

Intention-to-treat-analysis: analysis based on the initial treatment intent, not on that eventually administered, withdrawal from treatment or deviation from the protocol

Intraclass correlation coefficient (ICC): descriptive statistic for quantitative measurements to indicate how strongly units in the same group resemble each other.

Kaiser–Meyer–Oklin value: measure of 'Sampling Adequacy' should exceed the recommended minimum value such as 0.6 or 0.8 depending on the sample size and requirements.

Kolmogorov–Smirnov (K–S) test for normality: statistical nonparametric method for comparing the empirical distribution functions of two samples, i.e. to quantify distances between the sample and the reference distribution.

Likelihood Ratio (LR): Sensitivity/(1 – Specificity).

Maximum likelihood extraction: method of extracting common variables to make multivariate data simpler and easier to understand through correlations between factors, but requires the assumption of multivariate normality.

Measurement of outcome measures: 25-item dichotomous tool to assist quantification of the quality of a patient reported outcome (PRO) measurement questionnaire.

Meng's test of significance: unbiased significance test

Minimal detectable change (MDC): minimal change that falls outside the measurement error in the score of an instrument.

Minimal clinically important difference (MCID): smallest improvement considered worthwhile by a patient.

Pearson coefficient: represents the relationship between two variables that are measured on the same interval or ratio scale.

Principle component analysis (PCA): method of extracting common variables to make multivariate data simpler and easier to understand, but requires no distributional assumptions.

Psychometric properties: elements contributing to the statistical adequacy of the instrument in terms of reliability, validity and internal consistency.

Reliability: precision or consistency of a measure determined by the variance of repeated measurements, the degree to which a test is free of random error.

Responsiveness: ability of a scale to measure clinical change.

Scree plot curve: plots the extracted components as X and Y axis, with the critical point being where drop ceases and the curve 'inflects' towards lesser values (in factor analysis).

Sensitivity: proportion of cases with the condition that the test correctly detects, e.g. being absent for the stated period at a specific cut-off score.

Specificity: proportion of cases without condition that the test correctly detects, eg. being absent for the stated period correctly classified at a specific cut-off score.

Standard error of the measurement (SEM): estimate of error to use in interpreting an individual's test score.

Standard response mean (SRM): mean change score divided by standard deviation of the change score.

***t*-statistic**: ratio of the coefficient to its standard error; how extreme a statistical estimate is.

Varimax rotation: (in factor analysis) variance maximizing rotation of the original variable space, rotation of the vector of factors to find key combinations that simplify the analysis.

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