



## Health professionals' referral practice and related healthcare utilization for people with low back pain in Singapore: A retrospective study

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**Background:** Low back pain is a common musculoskeletal disorder that can incur high financial burden. A significant proportion of this burden may be incurred from referrals to health services and subsequent healthcare usages. Patients' overall experience of pain and its related life interferences may also have some relevance to this usage.

**Objective:** This study aimed to examine the referral practices and subsequent health service utilization of patients with LBP within a tertiary specialist clinic setting. A secondary objective was to explore potential associations between primary independent variables of pain and life interferences with health service utilization.

**Methods:** Participants were patients with low back pain, who completed a set of self-reported low back pain measures. These included measures for pain intensity, pain interference, disability and quality of life. The participants' back pain-related referral and health service utilization in the subsequent 12 months were recorded.

**Results:** A total of 282 patients completed the full measures. Of these, 59.9% were referred for physiotherapy, 26.3% for diagnostic imaging and 9.2% for interventional procedures. Compared to patients who were referred from tertiary care, those from primary care had lower pain intensity ( $p = 0.001$ ), pain interference ( $p = 0.002$ ), disability ( $p = 0.001$ ), but better physical and mental quality of life ( $p < 0.001$ ,  $p = 0.017$ ). High pain interference was a common factor among patients who were referred on to other services after first consultation. Levels of medical utilization and physiotherapy utilization were both associated with pain intensity ( $F = 2.39$ ,  $p = 0.027$  vs  $F = 3.87$ ,  $p = 0.001$ ), pain interference ( $F = 5.56$ ,  $p = 0.007$  vs  $F = 4.12$ ,  $p = 0.01$ ) and disability ( $F = 5.89$ ,  $p = 0.001$  vs  $F = 3.40$ ,  $p = 0.016$ ). Regression analysis showed that the source of referral contributed to 6% of the variance in medical utilization and 3% of the variance in physiotherapy utilization. After controlling the

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demographic variables and referral sources, none of the independent variables added any significant variance to medical utilization. Only pain intensity contributed an additional 2% variance to physiotherapy utilization.

**Conclusion:** Referral patterns and practices appear similar to those reported in other studies. Higher levels of pain intensity, interference, disability and quality of life appear to influence the referral to different health services and subsequent treatment utilization.

**Keywords:** Low back pain; referral and consultation; pain measurement.

## Introduction

Low back pain (LBP) is a common musculoskeletal condition worldwide. A systematic review of studies reporting incidences of LBP, conducted in Canada, United Kingdom (UK), Denmark, Israel and Kuwait, suggested an annual incident estimate of 1.5–36% for LBP.<sup>1</sup> The annual estimate of new incidences of LBP was reported to range from 6.3% to 15.4% in these countries. A recent large survey, conducted in the UK with 15,000 people with LBP, reported a one-month prevalence rate of 28.5% for this condition. Incidences of severe LBP were shown to increase with age, with these incidences peaking in the 41–50 age group.<sup>2</sup> A systematic analysis for the Global Burden of Disease Study 2013 ranked LBP as the leading cause of years lived with disability.<sup>3</sup>

The global economic burden of LBP is also high. A systematic review on the global cost of LBP, between 1997 and 2007, estimated the annual cost of illness to range from US\$1.2 billion to US\$25 billion.<sup>4</sup> Cost of illness calculation includes three main types of costs: (a) direct (medical and non-medical) costs; (b) indirect costs; and (c) intangible costs. These different categories of costs make the accurate estimation of the cost of illness of LBP rather challenging. As such, studies have instead focused on direct costs of LBP, which mostly comprised medical healthcare-related costs.

The reported annual medical cost for LBP in the US was US\$70 million.<sup>5</sup> More recent studies estimate direct healthcare costs to be €2.6 billion in Switzerland or 29% of the total cost of illness of LBP.<sup>6</sup> In France, 25% of the total direct costs are related to therapeutic and hospital care or rehabilitation care for LBP.<sup>7</sup> Results from a retrospective cohort study in the UK demonstrated that general healthcare costs for people with chronic LBP were three times greater than those without this condition.<sup>8</sup> Healthcare costs of chronic LBP were also found to be twice as high compared to those with acute LBP.<sup>7</sup>

Medical comorbidities, such as hypertension and coronary heart diseases commonly found in LBP sufferers as well as depression and anxiety disorders, appear to contribute to increased healthcare costs.<sup>5,8</sup> High disability and limitation in function from chronic LBP could increase subsequent direct healthcare costs by up to fivefolds.<sup>7</sup> A study of the trend of health expenditures, healthcare utilization and health statuses of people with spine problems in the US showed an increasing trend in these areas.<sup>9</sup>

A key systematic review of eight population-based studies, conducted from 1995 to 2005, indicated that the prevalence of care-seeking among LBP sufferers was 58%(10). Further, a population-based mailed survey of the epidemiology of LBP in Australia reported 44.5% prevalence in care-seeking behavior,<sup>11</sup> while a similar survey conducted in the United States reported a higher prevalence rate at 67.4%.<sup>12</sup> While one in three adults in the UK suffers from LBP, it was found that only about 20% of these sufferers would consult their General Practitioner (GP).<sup>13</sup> People with greater disability were more likely to seek care (OR: 3.87), with other factors such as gender, previous LBP history and poor general health also influencing care-seeking behavior.<sup>10</sup> A prospective cohort study of LBP in a hospital-tertiary setting suggested that healthcare utilization was also mediated by physical functioning and social stresses.<sup>14</sup>

It is a common healthcare practice for individuals with LBP to be referred on to further healthcare services such as diagnostic imaging, specialist care and therapy services after their first healthcare professional consultation. However, the decision to refer patients for subsequent healthcare services does not appear to be governed by specific treatment guidelines. A study of referral patterns by primary care physicians demonstrated that the decision to refer to specialty care including physiotherapy was influenced by the characteristics within the healthcare system, the physician and

the patient.<sup>15</sup> Referral rates were higher for individuals with higher education, employer or insurance coverage, and in specific geographical locations.<sup>16–18</sup> The odds of seeking care from a physiotherapist were 65% higher in females, and these individuals were twice as likely to be in the higher income category (OR: 2.09).<sup>12</sup> Other patient-related factors influencing referral decision was related to the presented LBP problem. Specialist care was found to be the strongest predictor of individuals with LBP receiving subsequent diagnostic imaging, physiotherapy and other healthcare services.<sup>19</sup>

Studies have shown that referrals to diagnostic imaging for LBP were related to patient–physician interactions and expectations rather than a purely medical consideration.<sup>20</sup> This discordance was also observed in a survey of GPs in Australia where 25.3% of individuals with acute LBP were referred for imaging, contrary to the established LBP treatment guidelines.<sup>21</sup> Specific to physiotherapy referrals, a cross-sectional analysis of Spine physicians in the US suggested that certain spinal diagnoses, surgeries, injections and multiple tests were negatively associated with such referrals.<sup>16</sup> Higher disability was also found to be negatively related to physiotherapy referrals<sup>16</sup> with referrals to physiotherapy related to lower self-rating of health status (OR 1.93).<sup>12</sup>

There is limited data on the referral practices and health service utilization in LBP within Southeast Asia. In a recent epidemiological study, LBP was ranked as the leading cause of years lived in disability in Southeast Asian countries, such as Indonesia, Malaysia, Philippines and Vietnam.<sup>3</sup> Work-related LBP's Daily Adjusted Life Years (DALYs) lost in Southeast Asia, after taking socioeconomic situations into consideration, was still found to be higher here than in other parts of the world.<sup>22</sup> Documenting the referral practices and subsequent health service utilization and their relation to pain and life interference could be a start towards building understanding of the healthcare burden of LBP in Southeast Asia.

The primary purpose of this study was to examine the referral practices and utilization of healthcare services in patients presenting with LBP and referred to a tertiary pain clinic setting in Singapore. We were also interested to explore associations between primary independent variables of pain and life interferences with healthcare utilization. Results can help guide the future design of triage and interventions that may potentially address such levels of healthcare utilization.

The study protocol was approved by the National Healthcare Group Institutional Review Board, Singapore (NHG DSRB Ref: 2012/00364). Waiver of Informed Consent was approved and observed for all the participants involved in the study.

## Material and Methods

### *Design*

This was a retrospective cohort study of LBP patients from a Singapore tertiary care hospital.

### *Participants*

Participants were patients, who were referred for complaints of LBP and had their first consultations between January and December 2011 at the pain clinic. Patients were included if they were (a) between 18 and 65 years, (b) presented with a primary complaint of LBP at first consultation, (c) able to complete a full set of standardized measures in either English or Mandarin. Patients were excluded if they were presented with some form of cognitive impairment or mental health condition diagnosis that affected their ability to complete a full set of standardized measures.

### *Procedures*

Patients who attended their first consultation at the pain clinic were asked to complete a set of standardized self-reported LBP measures on arrival at the clinic. Patients were reviewed by the respective pain specialists upon completion of these measures. Every patient underwent a comprehensive assessment including history taking, physical examination and electronic notes review as part of the standard pain consultation. The specialists would diagnose and establish management plans with the participants with the option of referring to their self-reported standardized measures as part of their assessment. The management plans could include referrals for further diagnostic imaging, consultations with other disciplines, interventional procedures and rehabilitation services as well as follow-up consultations. The above processes were documented in standard medical case records. In the case of referrals to other health services, appointments to the relevant services were made after the consultation. Changes in

management plans were also similarly documented and followed up.

### ***LBP diagnoses***

The diagnosis of LBP was determined by the respective pain specialists examining the cases. The diagnosis of LBP was classified according to the “Classification of Chronic Pain (Second Edition)”, as set out by the International Association for the Study of Pain (IASP).<sup>23</sup> Specifically, the patients presented with one of the following diagnoses contributing to a broad category of low back pain: (1) Lumbar spinal or radicular pain attributable to a fracture (XXVI-1), (2) Lumbar spinal or radicular pain attributable to arthritis (XXVI-5), (3) Lumbar spinal pain of unknown or uncertain origin (XXVI-9), (4) Lumbar spinal or radicular pain after failed spinal surgery (XXVI-10), (5) Lumbar discogenic pain (XXVI-11), (6) Lumbar zygapophysial joint pain (XXVI-13), (7) Lumbar instability (XXVI-21), (8) Prolapsed intervertebral disc (XXVI-23), (9) Spinal stenosis: Cauda Equina lesion (XXVII-6), (10) Sacral spinal pain of unknown or uncertain Origin (XXVII-9), (11) Sacroiliac joint pain (XXVII-10). All participants had a chronic low back pain onset of more than 3 months. Case notes and documentations were inspected retrospectively to verify that each participant had a primary LBP diagnosis and that clinic visits, procedures and hospital admissions were related to the treatment of LBP.

### **Referral Practice and Utilization Data**

The referral and healthcare utilization data on LBP were tracked for 1 year subsequent to the first consultation. Healthcare utilization was defined as the number of visits made by the patient to each health service discipline. These included the number of visits to the doctors, physiotherapists and psychologists, the number of interventional procedures and diagnostic imaging conducted, as well as the admissions to hospital (inpatient admission) relating only to the diagnosis of LBP. The case notes inspection included those from orthopaedic, rheumatology, neurosurgery, rehabilitation medicine and pain management clinics. The data on referral patterns were inferred from visits to other services subsequent to the primary medical consultation.

### **Measures**

Demographic measures which included age, gender, race, marital status, education level and occupation were recorded.

#### ***Pain intensity and pain interference***

Self-reported pain intensity and pain interference were measured using the Brief Pain Inventory (BPI).<sup>24</sup> Pain intensity was measured on a 0 (no pain) to 10 (worst pain possible) scale. Pain interference was assessed across seven domains, namely, general activity, mood, walking, normal work, relations with other persons, sleep and enjoyment of life. The BPI was found to have acceptable levels of reliability and validity in the assessment of pain intensity and pain interference in patients with non-malignant pain. The Cronbach  $\alpha$  internal coefficient was 0.85 for the intensity scale and 0.88 for the interference scale.<sup>25</sup>

#### ***Disability***

Self-reported disability was measured using the Oswestry Disability Index (ODI).<sup>26</sup> The ODI is one of the two widely used disability measures in LBP population.<sup>27</sup> It comprises 10 sections, covering 10 aspects of abilities. In each section, respondents choose 1 of 6 choices that each carried a score ranging from “0” (able to perform without limitation) or “5” (totally unable to perform). The final score is tabulated as a percentage of the total possible score of the relevant sections.<sup>26</sup>

#### ***Quality of life***

The self-reported quality of life (QoL) was measured using the Medical Outcome Study (MOS) 36-items Short Form Health Survey (SF-36).<sup>28</sup> The SF-36 consisted of 36 questions that measure the health concepts of physical, role, social functioning, mental health and general health perception, bodily pain and vitality.<sup>29</sup> These domains were then grouped to form two health dimension scales: the physical and mental composite scores. The SF-36 served as a good QoL measure for people with low back pain.<sup>27,29</sup> In chronic pain, the SF-36 Mental Composite Score was shown to have positive predictive value for mood issues.<sup>30</sup>



## Statistical Analysis

Pain intensity was computed taking the average of worst, least and average pain intensities on the BPI to form one composite pain intensity score. This score was used in all subsequent analysis. The ODI scores were originally categorized as mild (0–20%), moderate (21–40%), severe disability (41–60%), crippled (61–80%) and bed bound (81–100%).<sup>31</sup> To account for skewness of the data, the categories of ‘Severe disability’, ‘Crippled’ and ‘Bed bound’ were re-computed as a single ‘Severe disability’ (41–100%) component.

The SF-36 physical composite score (physical QoL) and mental composite score (mental QoL) were computed from the SF-36 questionnaire and used in the subsequent analysis. A secondary analysis was performed, which focused on examining the relationship between pain intensity, pain interference, disability and physical and mental quality of life with healthcare utilization. The between-group differences were examined with independent, two-tailed *t*-test and analysis of variance (ANOVA). Homogeneity of variances was tested and in cases where the assumption of the homogeneity of variance was violated, Welch’s ANOVA was applied to adjust for this violation. Post hoc Games-Howell analyses were used to examine the between-group differences, when there were more than two groups of variables. Hierarchical regression models were calculated to examine the possible predictors for medical and physiotherapy utilization, when demographic variables were controlled for. The data were analyzed using SPSS for windows, version 21.

## Results

A total of 298 patients completed the full measures, with 282 (94.6%) participants having a primary LBP diagnosis. Out of these, 138 (48.9%) were referred from primary care, and 144 (51.1%) were referred from tertiary care. The mean age was 46 years (SD = 18.2), with males making up 52.8% of the total number of patients. The baseline demographic characteristics and LBP diagnoses of patients are summarized in Table 1.

Patients who were referred from tertiary care were older ( $50.11 \pm 18.23$  years) than those referred from primary care ( $43.22 \pm 18.0$  year;  $F = 10.21$ ,  $p = 0.002$ ). Patients who were subsequently referred for interventional procedures after

Table 1. Demographic characteristics and LBP diagnoses of study sample ( $N = 282$ ).

Demographic characteristic	<i>n</i> (%)
Gender (male)	149 (52.8)
Race	
Chinese	217 (77.0)
Malay	19 (6.7)
Indian	27 (9.6)
Others	19 (6.7)
Marital Status	
Married	161 (57.1)
Divorced/Separated	14 (5.0)
Single	90 (31.9)
Widowed	14 (5.0)
Unknown	3 (1.0)
Years of education	
More than 12 years	104 (36.9)
12 years	19 (6.7)
10 years	61 (21.6)
Less than 10 years	39 (13.9)
Other qualifications	53 (18.8)
Unknown	6 (2.1)
Occupation	
Non Physical Work	156 (55.3)
Physical Work	28 (10.0)
Housewife	33 (11.7)
Student	24 (8.5)
Retiree	22 (7.8)
Unemployed/Unknown	19 (6.7)
Clinical Diagnosis of LBP	<i>n</i> (%)
Lumbar Spinal or Radicular Pain Attributable to a Fracture (XXVI-1)	3 (1.1)
Lumbar Spinal or Radicular Pain Attributable to Arthritis (XXVI-5)	1 (0.4)
Lumbar Spinal Pain of Unknown or Uncertain Origin (XXVI-9)	176 (62.4)
Lumbar Spinal or Radicular Pain after Failed Spinal Surgery (XXVI-10)	2 (0.7)
Lumbar Discogenic Pain (XXVI-11)	19 (6.7)
Lumbar Zygapophysial Joint Pain (XXVI-13)	23 (8.2)
Lumbar Instability (XXVI-21)	7 (2.5)
Prolapsed Intervertebral Disk (XXVI-23)	16 (5.7)
Spinal Stenosis: Cauda Equina Lesion (XXVII-6)	15 (5.3)
Sacral Spinal Pain of Unknown or Uncertain Origin (XXVII-9)	15 (5.3)
Sacroiliac Joint Pain (XXVII-10)	5 (1.8)

medical consultation were also older ( $54.60 \pm 18.66$  years versus  $45.91 \pm 18.22$  years;  $F = 5.52$ ,  $p = 0.019$ ), as were patients who had recorded hospital admissions ( $61 \pm 19.42$  versus  $45.98 \pm 18.08$  years;  $F = 9.38$ ,  $p = 0.002$ ). There were no other baseline between-group differences in demographic characteristics between patients included in this study. Patients referred from tertiary care

Table 2. Mean scores and between-group differences of self-reported LBP measures and healthcare utilization (medical and physiotherapy) of patients referred from primary care and tertiary care settings.

	Primary care Mean $\pm$ SD (95%CI)	Tertiary care Mean $\pm$ SD (95%CI)	<i>P</i> -value
Age	43.22 $\pm$ 18.0 (40.19–46.25)	50.11 $\pm$ 18.23 (47.11–53.11)	0.002**
Self-reported LBP Measures			
Pain intensity	4.20 $\pm$ 1.59 (3.93–4.46)	4.86 $\pm$ 1.64 (4.59–5.13)	0.001**
Pain interference	4.09 $\pm$ 2.38 (3.69–4.49)	5.00 $\pm$ 2.41 (4.60–5.40)	0.002**
Disability	25.03 $\pm$ 15.33 (22.45–27.61)	34.79 $\pm$ 19.37 (31.6–38.00)	< 0.001***
Physical quality of life	51.96 $\pm$ 21.23 (48.39–55.54)	39.85 $\pm$ 21.91 (36.24–43.46)	< 0.001***
Mental quality of life	61.63 $\pm$ 21.83 (57.96–65.30)	55.04 $\pm$ 24.30 (51.04–59.04)	0.017*
Health service utilization			
Medical utilization	2.72 $\pm$ 2.09 (2.37–3.07)	4.44 $\pm$ 3.90 (3.80–5.09)	< 0.001***
Physiotherapy utilization	2.30 $\pm$ 3.15 (1.77–2.83)	3.44 $\pm$ 4.99 (2.61–4.26)	0.023*

Notes: SD: standard deviation; CI: confidence interval. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . Data was adjusted for non-homogeneity of variance.

had higher medical ( $p < 0.001$ ) and physiotherapy utilization ( $p = 0.023$ ).

### ***Health service referrals and self-reported LBP measures***

Results showed that patients referred to the clinic from tertiary care had higher pain intensity ( $p = 0.001$ ), pain interference ( $p = 0.002$ ), disability ( $p = 0.001$ ), and poorer physical and mental QoL ( $p < 0.001$ ,  $p = 0.017$ ). Table 2 shows the mean scores and between-group differences of self-reported measures in patients referred from primary care and tertiary care.

Patients who were referred to physiotherapy (59.92%) were found to have higher pain interference ( $p = 0.0018$ ) and poorer physical QoL ( $p = 0.04$ ). Those referred for diagnostic imaging (26.24%) also reported higher pain interference ( $p = 0.04$ ), disability ( $p = 0.03$ ), and lower mental QoL ( $p = 0.01$ ). Patients referred for interventional procedures (9.22%) not only reported higher pain interference ( $p = 0.003$ ) and disability ( $p = 0.001$ ) but also lower levels of both mental ( $p = 0.013$ ) and physical QoL ( $p = 0.001$ ). Patients who had subsequent hospital admissions (4.96%) were worse on all self-reported measures ( $p < 0.05$ ). Data on the referrals to different health services and their respective scores on the LBP measures are provided in Table 3.

### ***Health service utilization and self-reported LBP measures***

Patients attended an average of  $3.60 \pm 3.26$  medical visits, with those referred to physiotherapy attending  $4.81 \pm 4.53$  visits. An average of  $1.36 \pm 0.93$  imaging studies were performed for those referred to diagnostic imaging, and  $1.04 \pm 0.2$  interventional procedures were completed. Between-group comparison of pain intensity, pain interference and disability with medical and physiotherapy utilization is provided in Table 4.

The medical utilization was found to be associated with pain intensity ( $F = 2.39$ ,  $p = 0.027$ ), pain interference ( $F = 5.56$ ,  $p = 0.007$ ), and disability ( $F = 5.89$ ,  $p = 0.001$ ). Post hoc Games-Howell analyses showed that medical utilization was significantly lower in patients with mild pain intensity ( $p = 0.032$ ), low pain interference ( $p = 0.006$ ), and mild disability ( $p = 0.006$ ). Medical utilization was also lower in patients who were not referred to physiotherapy ( $2.31 \pm 2.00$ ; 95%CI 1.94–2.68) compared to those who were referred ( $4.46 \pm 3.64$ ; 95%CI 3.91–5.01;  $F = 32.81$ ,  $p < 0.001$ ).

Similar to the results obtained from ANOVA analysis of medical utilization, the physiotherapy utilization was also associated with pain intensity ( $F = 3.87$ ,  $p = 0.001$ ), pain interference ( $F = 4.12$ ,  $p = 0.01$ ), and disability ( $F = 3.40$ ,  $p = 0.016$ ). Post hoc analyses also showed that similar results in patients with mild pain intensity ( $p = 0.006$ ), low pain interference ( $p = 0.03$ ) and mild disability

Table 3. Referral to other health services and between-group differences in self-reported LBP measures.

Descriptor	Referred <i>n</i> (%)	Not referred <i>n</i> (%)	Referred mean (SD)	Not referred mean (SD)	Mean difference	95% CI	<i>P</i> -value
Physiotherapy	169 (59.92)	113 (40.07)					
Pain intensity			4.65 (1.65)	4.37 (1.64)	0.28	-0.11-0.67	0.16
Pain interference			4.84 (2.29)	4.12 (2.60)	0.72	0.12-1.31	0.018*
Disability			31.44 (16.73)	27.88 (19.99)	3.57	-0.92-8.06	0.11
Physical quality of life			43.56 (20.30)	49.09 (24.91)	-5.53	-10.85-(-0.20)	0.04*
Mental quality of life			57.14 (22.06)	59.96 (25.09)	-2.82	-8.40-2.76	0.32
Diagnostic imaging	74 (26.24)	208 (73.76)					
Pain intensity			4.63 (1.56)	4.50 (1.68)	0.12	-0.30-0.55	0.57
Pain interference			5.01 (2.19)	4.39 (2.51)	0.62	-0.02-1.27	0.04*
Disability			33.81 (17.04)	28.66 (18.38)	5.15	0.49-9.80	0.03*
Physical quality of life			41.81 (21.06)	47.19 (22.72)	-5.38	-11.13-0.38	0.07
Mental quality of life			52.26 (23.60)	60.40 (22.89)	-8.15	-14.42-(-1.88)	0.01**
Interventional procedure	26 (9.22)	256 (90.78)					
Pain intensity			4.86 (1.46)	4.51 (1.66)	0.35	-0.27-0.97	0.26
Pain interference			6.04 (2.43)	4.40 (2.40)	1.64	0.66-2.61	0.003**
Disability			41.62 (16.33)	28.87 (17.97)	12.75	5.82-19.67	0.001***
Physical quality of life			32.19 (16.52)	47.11 (22.49)	-14.92	-23.84-(-5.99)	0.001***
Mental quality of life			47.27 (22.08)	59.35 (23.23)	-12.08	-21.40-(-2.76)	0.013**
Inpatient admission	14 (4.96)	268 (95.04)					
Pain intensity			5.74 (1.72)	4.47 (1.62)	1.27	0.26-2.27	0.017*
Pain interference			6.50 (2.74)	4.45 (2.38)	2.05	0.45-3.65	0.016*
Disability			49.71 (16.62)	28.99 (17.66)	20.73	10.96-30.50	< 0.001***
Physical quality of life			24.71 (15.15)	46.88 (22.17)	-22.16	-33.98-(-10.35)	< 0.001***
Mental quality of life			36.21 (23.70)	59.42 (22.76)	-23.20	-37.09-(-9.32)	0.003**

Notes: SD: standard deviation; CI: confidence interval. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . Data was adjusted for non-homogeneity of variance.

( $p = 0.043$ ) were more likely to have lower number of physiotherapy visits.

Correlation analysis showed only negligible to small relationships ( $r = 0.05$ - $0.22$ ) between healthcare utilization (medical and physiotherapy) and variables of pain intensity, pain interference, disability and QoL (physical and mental). Results of the individual analyses are not reported here.

Regression analyses were conducted to examine potential predictors for medical and physiotherapy utilization. Specifically, known confounders such as demographic variables of age, gender and education were controlled for in the first block, followed by referral source and pain intensity. Quality of life, disability and pain interference which are meaningful treatment outcomes in chronic pain management were subsequently added into the regression order. Pain interference is often a primary dependent variable that is examined in many pain studies. Hence, it was added in as the last block in the hierarchical regression. We were interested to examine whether pain interference

would be able to account for the variance in medical and physiotherapy utilization in our sample of patients beyond the other dependent variables examined here. The results of the regression showed that the source of referral contributed to 6% of the variance in medical utilization and 3% of the variance for physiotherapy utilization. After controlling for demographic variables and referral sources however, none of the dependent variables of pain intensity, quality of life, disability or pain interference added any significant variance to medical utilization. Among the dependent variables, only pain intensity contributed an additional 2% variance to physiotherapy utilization. Table 5 shows the results of the linear regression models examining predictors for medical and physiotherapy utilization.

## Discussion

This study presents a report of LBP-related healthcare referral and utilization within a cohort,

Table 4. Between-group comparison of LBP measures and number of physiotherapy and medical visits.

LBP measures	<i>F</i> -value	<i>P</i> -value	Severity (I)	Number of visits		Severity (J)	Number of visits		<i>P</i> -value
				Mean $\pm$ SD (95% CI)	Mean $\pm$ SD (95% CI)		Mean $\pm$ SD (95% CI)	Mean $\pm$ SD (95% CI)	
<b>Medical Utilization</b>									
Pain intensity	2.39	0.027*	Mild ( <i>n</i> = 58)	2.91 $\pm$ 2.19 (2.34–3.49)	3.65 $\pm$ 3.55 (3.13–4.17)	Mod ( <i>n</i> = 181)	3.65 $\pm$ 3.55 (3.13–4.17)	–0.73 [SE: 0.39; CI: –1.66–0.19]	0.15
						Severe ( <i>n</i> = 43)	4.33 $\pm$ 3.07 (3.38–5.27)	–1.41 [SE:0.55; CI: –2.73–(–0.10)]	0.032*
Pain interference	5.56	0.007**	Low ( <i>n</i> = 100)	2.89 $\pm$ 2.93 (2.31–3.47)	3.63 $\pm$ 3.14 (3.04–4.22)	Mod ( <i>n</i> = 111)	3.63 $\pm$ 3.14 (3.04–4.22)	–0.74 [SE: 0.42; CI: –1.73–0.25]	0.18
						High ( <i>n</i> = 71)	4.55 $\pm$ 3.67 (3.68–5.42)	–1.66 [SE: 0.52; CI: –2.90–(–0.41)]	0.006**
Disability	5.89	0.001***	Mild ( <i>n</i> = 106)	2.75 $\pm$ 2.53 (2.27–3.24)	4.12 $\pm$ 3.89 (3.34–4.90)	Mod ( <i>n</i> = 99)	4.12 $\pm$ 3.89 (3.34–4.90)	–1.37 [SE: 0.46; CI: –2.46–(–0.27)]	0.01**
						Severe ( <i>n</i> = 77)	4.09 $\pm$ 3.06 (3.40–4.78)	–1.34 [SE: 0.43; CI: –2.35–(–0.33)]	0.006**
<b>Physiotherapy Utilization</b>									
Pain intensity	3.87	0.001***	Mild ( <i>n</i> = 58)	1.72 $\pm$ 1.86 (1.23–0.21)	2.98 $\pm$ 4.37 (2.34–3.62)	Mod ( <i>n</i> = 181)	2.98 $\pm$ 4.37 (2.34–3.62)	–1.26 [SE: 0.41; CI: –2.22–(–0.30)]	0.006**
						Severe ( <i>n</i> = 43)	4.02 $\pm$ 5.47 (2.34–5.71)	–2.30 [SE: 0.87; CI: –4.40–(–0.20)]	0.029*
Pain interference	4.12	0.01**	Low ( <i>n</i> = 100)	1.92 $\pm$ 3.57 (1.21–2.63)	3.39 $\pm$ 4.72 (2.50–4.28)	Mod ( <i>n</i> = 111)	3.39 $\pm$ 4.72 (2.50–4.28)	–1.47 [SE:0.57; CI: –2.82–(–0.12)]	0.03*
						High ( <i>n</i> = 71)	3.45 $\pm$ 4.08 (2.49–4.42)	–1.53 [SE: 0.60; CI: –2.96–(–0.11)]	0.035*
Disability	3.40	0.016*	Mild ( <i>n</i> = 106)	2.05 $\pm$ 2.93 (1.48–2.61)	3.44 $\pm$ 4.97 (2.45–4.44)	Mod ( <i>n</i> = 99)	3.44 $\pm$ 4.97 (2.45–4.44)	–1.40 [SE: 0.57; CI: –2.76–(–0.04)]	0.043*
						Severe ( <i>n</i> = 77)	3.31 $\pm$ 4.56 (2.28–4.35)	–1.26 [SE: 0.59; CI: –2.66–0.14]]	0.087

Notes: SD: standard deviation; SE: standard error; CI: 95% confidence interval. \**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001. Data was adjusted for non-homogeneity of variance.



Table 5. Hierarchical regression models examining predictors for medical and physiotherapy utilization.

Step		Medical utilization			Physiotherapy utilization		
		Adj. R <sup>2</sup>	R <sup>2</sup>	$\beta$	Adj. R <sup>2</sup>	R <sup>2</sup>	$\beta$
1		-0.01	0.01		0.00	0.01	
	Age			0.07			-0.08
	Gender			-0.02			-0.09
2	Education	0.06	0.07	-0.02	0.02	0.04	-0.02
	Age			0.01			-0.12
	Gender			-0.01			-0.09
	Education			-0.06			-0.04
3	Referral Source	0.07	0.08	-0.27***	0.04	0.06	-0.16**
	Age						-0.12
	Gender			-0.01			-0.07
	Education			-0.001			-0.02
	Referral source			-0.04			-0.13
4	Pain intensity	0.08	0.10	0.10	0.04	0.06	0.15*
	Age			-0.02			-0.13
	Gender			0.02			-0.07
	Education			-0.04			-0.02
	Referral source			-0.23			-0.11
	Pain intensity			0.03			0.12
	Physical QoL			-0.09			-0.13
	Mental QoL			-0.08			0.09
5		0.10	0.10		0.04	0.06	
	Age			-0.03			-0.14
	Gender			0.02			-0.07
	Education			-0.04			-0.02
	Referral source			-0.23			-0.11
	Pain intensity			0.01			0.11
	Physical QoL			-0.05			-0.10
	Mental QoL			-0.07			0.10
6	Disability	0.11	0.11	0.09	0.04	0.07	0.06
	Age			-0.02			-0.13
	Gender			0.02			-0.07
	Education			-0.05			-0.03
	Referral source			-0.23			-0.11
	Pain intensity			-0.01			0.09
	Physical QoL			-0.04			-0.09
	Mental QoL			-0.05			0.12
	Disability			0.06			0.04
Pain interference	0.07	0.07					

Notes: QoL: quality of life; Adj.: adjusted;  $\beta$ : standardized coefficients beta. \* $p < 0.05$ ; \*\* $p < 0.01$  and \*\*\* $p < 0.001$ .

tertiary hospital clinic setting in Southeast Asia. Results showed that those referred from tertiary care had greater pain and life interference, and greater medical and physiotherapy utilization. Patients referred to physiotherapy had higher pain interference and poorer physical QoL. Those referred to diagnostic imaging, interventional procedures, and admitted showed more extensive pain

and life interference. High pain intensity, pain interference, and disability were associated with medical and physiotherapy utilization. Source of referral significantly contributed to medical and physiotherapy utilization, while pain intensity was a significant predictor for physiotherapy utilization.

A total of 59.92% of patients were referred for physiotherapy. This referral rate was considerably

higher than the 38%–49% reported in studies in similar tertiary settings.<sup>16,19</sup> The relationship between physiotherapy referral and disability, as noted by Freburger *et al.*,<sup>16</sup> was not found here. The physicians in this study were specialists in pain management, unlike the spine surgeons or specialists from a variety of disciplines in both the studies. Physician specialties might be associated with different clinical practices when managing LBP. In addition, specific diagnoses of LBP, spinal surgeries, injections, multiple tests and the level of chronicity of LBP could also influence the rate of referral to physiotherapy.<sup>16,32</sup>

Referral rate for diagnostic imaging (26.24%) was lower than 32–46% reported in other studies within tertiary settings.<sup>7,17,18</sup> Patients referred to diagnostic imaging in this study reported higher levels of pain interference and disability, and lower levels of mental quality of life. Studies<sup>19</sup> have found low-functional capacity to be a strong predictor for referrals to imaging, and ordering of tests was highly influenced by factors related to the (1) attending physician, (2) psycho-social effects on the patients at the time of consultation and (3) the policy and practices of the healthcare organization.<sup>20,33</sup>

The mean medical utilization in this cohort study was 3.60 (SD = 3.26), which was lower than other cohort studies. The median number of specialist visit was 7 in the study by Chenot *et al.*, while those reported in a Japanese study were in the range of 6.46–11.44.<sup>19,34</sup> Physiotherapy utilization 4.81 (SD = 4.53) was lower compared to the 8.4 and 10.3 visits reported in tertiary settings.<sup>32,35</sup>

The healthcare system in Singapore is designed such that a referral gate control to specialist and therapy care is a common practice for subsidized care. The effectiveness and outcome of such a referral system in managing health usage, however, remains unclear. It would seem that although validated measures are available to capture health service utilization, patient outcomes and well-being, few of these have been used in specialty referral systems.<sup>36</sup> The presence of uniform medical insurance and ineffective referral gate-control mechanism was also found to be associated with higher healthcare usage.<sup>6,37</sup> This study noted that prior specialist care could be a predictor for greater medical utilization. Another earlier cohort study<sup>19</sup> has shown that specialist consultation was a stronger predictor for subsequent health service utilization than disease-specific factors.

The structure of the healthcare system and funding could influence the lower medical and physiotherapy usage observed here.

The specialists and physiotherapists in this study appeared to adopt a stratified approach to reviewing patients. Patients presenting with low or mild levels of pain intensity, interference and disability had lesser utilization during the subsequent 1 year period. These patients were likely to have been reviewed less frequently, or discharged after a shorter review period. The utilization increased when the pain intensity, interference or disability increased to moderate or severe levels. There appears to be a slight variation in practices between medical specialists and physiotherapists. The specialists tended to review patients more frequently when the pain intensity, pain interference and disability were in the high or severe range, while physiotherapists did so, when they reached the moderate range. Specific to the specialists included in this study, this finding potentially implies that their choice to review patients at a higher frequency could be related to a focus on diagnosis and managing more complex and severe LBP. This will also include assessing and managing red flags presented at consultation.

Compared to patients who were referred from primary care, those from tertiary care were older and had significantly higher pain intensity, pain interference, disability and lower physical and mental QoL. Outcomes of referral to specialists included clinical tasks such as diagnosis and treatment.<sup>36</sup> It is possible that specialists in this study exercise greater diligence in assessing and managing these patients. It was not a surprise that the source of referral was presented as a significant contributor to the medical and physiotherapy utilization.

Based on the regression findings, pain intensity was found to be a significant contributor to overall physiotherapy utilization, albeit a modest one. It is possible that physiotherapists may focus on pain intensity as a guide when planning the frequency and length of review. The possible reasons and implications of this contributor require more studies and thought. Pain intensity has been found to be associated with other pain-related cognitive factors such as catastrophizing and functional self-efficacy.<sup>38,39</sup> In recent years, psychologically-informed physiotherapy practice has been advocated to be the new clinical framework, whereby the patient should be considered within the relevant

psycho-social-economic contexts before delivering appropriate care.<sup>40</sup>

Although it was expected that pain intensity, pain interference, disability and quality of life would contribute a significant amount of variance to healthcare utilization, we found that these independent variables contributed a total of 3–4% variance. This might mean that there were many other factors that could be predictors for medical and physiotherapy utilization. These could include other condition-specific or patient-specific presentations. Musculoskeletal and neuropathic pain conditions, sleep disorders, anxiety and depressions were found to be significantly higher in people suffering from chronic LBP.<sup>41</sup> The duration of the LBP episode and the history of recurrence of LBP, and pain areas would be the common aspects considered by the healthcare professions in clinical examination. Greater chronicity of LBP had been related to increased physiotherapy utilization.<sup>32</sup> A combination of self-reported and objective measures could provide information about the chances of recurrences of LBP with radiating symptoms and neurological findings, which had been noted as a possible factor in future health service utilization.<sup>42–45</sup>

## Limitation of Study

This study was a retrospective cohort study that examined only one sample within one tertiary hospital. Including and comparing data from other tertiary pain centers could add greater dimension and completeness to the study results. This study did not include data on common psychosocial factors and comorbidities that had been previously found to be related to chronic LBP and health utilization, such as fear avoidance, hyper vigilance, depressive and anxiety disorders.<sup>5,14,41</sup> Data related to such factors were only collected from a small subset of patients seen at the pain clinic in this study, specifically those referred to the psychologist after their first visit to the clinic. The time-frame for referrals made to the psychologist from patient's first visit to the clinic were often inconsistent and sporadic. As such, these data were not included here. Information about these psychological factors may help explain the health utilization observed in this study. This can further clarify the contribution of pain intensity towards physiotherapy utilization.

The utilization of non-hospital-based therapy services, such as alternative complementary therapies

and visits to the primary care physicians or other specialists, were not examined here. Inclusion of these via interviews would provide a more complete picture about the influence of LBP complaints on care-seeking and utilization prior to and during the course of the study.

The use and reliance on limited self-reported measures may contribute another study limitation. The LBP condition has been thought to be inherently complex in both presentation and the delivery of care.<sup>46</sup> In this aspect, the self-reported condition-specific measures would only form a small part of the doctors' and physiotherapist's clinical decision-making. Utilizing such measures alone and obtaining data from a limited number of measures would likely be inadequate to explain the trends and patterns in healthcare utilization. Future studies should consider the inclusion of common clinical presentation, comorbidities and associated healthcare services utilized since the onset of LBP to extend the current understanding in this area. Such understanding can guide more targeted research into more cost- and clinically-effective LBP treatments.

## Recommendations

Based on the study findings, setting up a triage system for patients presenting with LBP at a tertiary care setting is potentially useful. Patients who are above 45 years of age, referred from tertiary care and presenting with high levels of self-reported pain intensity, pain interference and disability, can be given earlier appointment to see the specialist and physiotherapist. This would facilitate the process of specialized assessment, diagnosis and delivery of targeted intervention. The identified inadequacies of self-reported measures in predicting healthcare utilization, including examination of comorbidities such as depression, anxiety, sleep disorders, and presence of other pains in patient assessment, can add value to the model. Such data would be helpful in refining the triage system and empower patients in need of prompt specialist and physiotherapy care. Prompt and targeted care could be helpful in managing the chronicity of LBP and the subsequent burden on the patient.

## Conclusion

This study presented the referral and utilization of medical and physiotherapy services, within a

tertiary setting, in Southeast Asia. Self-reported LBP measures in pain, interference and disabilities appeared to influence the frequency and length of follow-up reviews by the doctors and physiotherapists. The referral and utilization patterns, and variations appeared to loosely concur with those reported in the existing literature. Future studies to examine clinician-related factors, objective examinations, and broader psycho-social-economic factors could provide more information to the referral and utilization practices within LBP management in Singapore.

### Conflict of Interest

The authors have no conflicts of interest relevant to this paper.

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### Author Contributions

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### References

1. Hoy D, Brooks P, Blyth F, Buchbinder R. The epidemiology of low back pain. *Best Practice & Research Clinical Rheumatology* 2010;24:769–781.
2. Macfarlane GJ, Beasley M, Jones EA, Prescott GJ, Docking R, Keeley P et al. The prevalence and management of low back pain across adulthood: results from a population-based cross-sectional study (the MUSICIAN study). *Pain* 2012;153:27–32.
3. Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015;386(9995):743–800.
4. Dagenais S, Caro J, Haldeman S. Systematic review of low back pain cost of illness studies in the United States and internationally. *The Spine Journal* 2008;8:8–20.
5. Ritzwoller DP, Crouse L, Shetterly S, Rublee D. The association of comorbidities, utilization and costs for patients identified with low back pain. *BMC Musculoskeletal Disorders* 2006;7:72, doi: 10.1186/1471-2474-7-72.
6. Wieser S, Horisberger B, Schmidhauser S, Eisenring C, Brügger R, Ruckstuhl A et al. Cost of low back pain in Switzerland in 2005. *European Journal of Health Economics* 2011;12:455–467.
7. Becker A, Held H, Redaelli M, Stauch K, Chenot JF, Leonhardt C et al. Low Back Pain in Primary Care Costs of Care and Prediction of Future Health Care Utilization. *Spine* 2010;35:1714–1720.
8. Hong J, Reed C, Novick D, Happich M. Costs associated with treatment of chronic low back pain. *Spine* 2012;38(1):77–82.
9. Martin BI, Turner JA, Mirza SK, Lee MJ, Comstock BA, Deyo RA. Trends in health care expenditures, utilization, and health status among US adults with spine problems, 1997–2006. *Spine* 2009;34:2077–2084.
10. Ferreira ML, Machado G, Latimer J, Maher C, Ferreira PH, Smeets RJ. Factors defining care-seeking in low back pain — A meta-analysis of population based surveys. *European Journal of Pain* 2010;14(7):747-e1.
11. Walker BF, Muller R, Grant WD. Low back pain in Australian adults. Health provider utilization and care seeking. *J Manipulative PhysiolTher* 2004;27(5):327–335.
12. Chevon J, Riddle DL. Factors Associated With Care Seeking From Physicians, Physical Therapists, or Chiropractors by Persons With Spinal Pain: A Population-Based Study. *J Orthop Sports PhysTher* 2011;41(7):467–476.

13. Macfarlane GJ, Jone GT, Hannaford PC. Managing low back pain presenting to primary care: where do we go from here? *Pain* 2006;122(3):219–222.
14. Keeley P, Creed F, Tomenson B, Todd C, Borglin G, Dickens C. Psychosocial predictors of health-related quality of life and health service utilisation in people with chronic low back pain. *Pain* 2008;135:142–150.
15. Forrest CB, Nutting PA, von Schrader S, Rohde C, Starfield B. Primary Care Physician Specialty Referral Decision Making: Patient, Physician, and Health Care System Determinants. *Med Decis Making* 2006;26:76–85.
16. Freburger JK, Carey TS, Holmes GM. Physician referrals to physical therapists for the treatment of spine disorders. *The Spine Journal* 2005;5(5):530–541.
17. Ivanova JI, Birnbaum HG, Schiller M, Kantor E, Johnstone BM, Swindle RW. Real-world practice patterns, health-care utilization, and costs in patients with low back pain: the long road to guideline-concordant care. *The Spine Journal* 2011;11:622–632.
18. Fritz JM, Childs JD, Wainner RS, Flynn TW. Primary care referral of patients with low back pain to physical therapy impact on future health care utilization and costs. *Spine* 2012;37(25):2114–21.
19. Chenot JF, Leonhardt C, Keller S, Scherer M, Donner-Banzhoff N, Pfingsten M et al. The impact of specialist care for low back pain on health service utilization in primary care patients: A prospective cohort study. *European Journal of Pain* 2008;12:275–283.
20. Baker R, Lecouturier J, Bond S. Explaining variation in GP referral rates for x-rays for back pain. *Implementation Science* 2006;1:15, doi: 10.1186/1748-5908-1-15.
21. Williams CM, Maher CG, Hancock MJ, McAuley JH, McLachlan AJ, Britt H et al. Low back pain and best practice care: A survey of general practice physicians. *Arch Intern Med* 2010;170(3):271–277.
22. Punnett L, Prüss-Ustün A, Nelson DI, Fingerhut MA, Leigh J, Tak S et al. Estimating the Global Burden of Low Back Pain Attributable to Combined Occupational Exposures. *Am J Ind Med*; 48:459–469.
23. Merskey, Harold, and Nikolai Bogduk. *Classification of Chronic Pain: Descriptions of Chronic Pain Syndromes and Definitions of Pain Terms*. Seattle: IASP Press, 1994. Print.
24. Cleeland CS, Ryan KM. *The brief pain inventory*. Pain Research Group 1991.
25. Tan G, Jensen MP, Thornby JI et al. Validation of the Brief Pain Inventory for chronic nonmalignant pain. *The Journal of Pain* 2004;5(2):133–137.
26. Roland M and Fairbank J. The Roland–Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine* 2000;25(24):3115–3124.
27. Bombardier C. Outcome assessments in the evaluation of treatment of spinal disorders: summary and general recommendations. *Spine* 2000;25:3100–3103.
28. Ware Jr JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. *Med Care* 1992;1:473–83.
29. McHorney CA, Ware JE, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and Clinical Tests of Validity in Measuring Physical and Mental Health Constructs. *Med Care* 1993;31(3):247–263.
30. Elliott TE, Renier CM, Palcher JA. Chronic Pain, Depression, and Quality of Life: Correlations and Predictive Value of the SF-36. *Pain Medicine* 2003;4(4):331–339.
31. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine* 2000; 25(22):2940–52.
32. Brooks G, Dolphin M, Vanbeveren P, Hart DL. Referral source and outcomes of physical therapy care in patients with low back pain. *J Orthop Sports PhysTher* 2012;42(8):705–715.
33. Whiting P, Toerien M, de Salis I, Sterne JAC, Dieppe P, Egger M et al. A review identifies and classifies reasons for ordering diagnostic tests. *J ClinEpidemiol* 2007;60:981–989.
34. Sadosky AB, DiBonaventura M, Cappelleri JC, Ebata N, Fujii K. The association between lower back pain and health status, work productivity, and health care resource use in Japan. *Journal of Pain Research* 2015;8:119–130.
35. Groenendijk JJ, Swinkels ICS, de Bakker D, Dekker J, van den Ende CHM. Physical therapy management of low back pain has changed. *Health Policy* 2007;80:492–499.
36. Guevara JP, Hsu D, Forrest CB. Performance measures of the specialty referral process: a systematic review of the literature. *BMC health services research*. 2011;11(1):168. Available at <http://doi.org/10.1186/1476-6963-11-168>.
37. Carey TS, Freburger JK, Holmes GM, Castel L, Darter J, Agans R et al. A long way to go: Practice patterns and evidence in chronic low back pain care. *Spine* 2009;34(7):718–724.
38. Severeijns R, Vlaeyen JWS, van den Hout MA, Weber WEJ. Pain catastrophizing predicts pain intensity, disability, and psychological distress independent of the level of physical impairment. *Clinical Journal of Pain* 2001;17:165–172.
39. Woby SR, Roach NK, Urmston M, Watson PJ. The relation between cognitive factors and levels of pain and disability in chronic low back pain patients presenting for physiotherapy. *European Journal of Pain* 2007;11:869–877.



40. Main CJ, George SZ. Psychologically informed practice for management of low back pain: Future directions in practice and research. *Physical Therapy* 2011;91:820–824.
41. Gore M, Sadosky A, Stacey BR, Tai KS, Leslie D. The burden of chronic low back pain: clinical comorbidities, treatment patterns, and health care costs in usual care settings. *Spine* 2012;37(11):E668-77.
42. Freburger JK, Holmes GM, Castel LD. The rising prevalence of chronic low back pain. *Arch Phys Med Rehabil* 2009;169(3):251–258.
43. Kääriä S, Mälkiä EA, Luukkonen RA, Leino-Arjas PI. Pain and clinical findings in the low back: A study of industrial employees with 5-, 10-, and 28-year follow-ups. *European Journal of Pain* 2010;14:759–763.
44. Konstantinou K, Hider S, Jordan, JL, Lewis M, Dunn KM, Hay EM. The impact of low back-related leg pain on outcomes as compared with low back pain alone: A systematic review of the literature. *Clin J Pain* 2013;29(7):644–654.
45. Martin BI, Deyo RA, Mirza SK, Turner JA, Comstock BA, Hollingworth W et al. Expenditures and health status among adults with back and neck problems. *JAMA* 2008;299:656–664.
46. Ford JJ, Hahne AJ. Complexity in the physiotherapy management of low back disorders: Clinical and research implications. *Manual Therapy* 2013;18:438–442.