Subclassification of low back pain: a cross-country comparison

Evdokia V. Billis · Christopher J. McCarthy ·
Jacqueline A. Oldham

Received: 11 November 2006 / Revised: 31 December 2006 / Accepted: 5 January 2007 / Published online: 17 March 2007
© Springer-Verlag 2007

Abstract Various health professionals have attempted to classify low back pain (LBP) subgroups and have developed several LBP classification systems. Knowing that culture has an effect on LBP symptomatology, assessment findings and clinical decision making, the aim of this review is to perform a cross-country comparative review amongst the published classification systems, addressing each country's similarities and differences as well as exploring whether cultural factors have been incorporated into the subclassification process. A systematic search of databases limited to human adults was undertaken by Medline, Cinahl, AMED and PEDro databases between January 1980 and October 2005. Classification systems from nine countries were identified. Most studies were classified according to pathoanatomic and/or clinical features, whereas fewer studies utilized a psychosocial and even less, a biopsychosocial approach. Most studies were limited in use to the country of the system's developer. Very few studies addressed cultural issues, highlighting the

lack of information on the impact of specific cultural factors on LBP classification procedures. However, there seem to be certain 'cultural trends' in classification systems within each country, which are discussed. Despite the plethora of classification studies, there is still no system which is internationally established, effective, reliable and valid. Future research should aim to develop a LBP classification system within a well identified cultural setting, addressing the multi-dimensional features of the LBP presentation.

Keywords Classification · Low back pain · Cross-country comparison · Cross-cultural · Culture

Introduction

Low back pain (LBP) is one of the commonest reasons for people to seek medical treatment in Western societies [3, 11, 42, 77, 90], with the majority of LBP sufferers being classified as having non-specific low back pain (NSLBP). This definition includes any type of back pain and/or referred leg pain which does not fall into the category of nerve root pain and of serious spinal pathology [22, 98]. For this patient group, it is still unknown what the optimal treatment is and subsequently, their management accounts for an extremely high cost for their country [64, 98]. One of the principal reasons for this is believed to be the fact that this large group is not uniform, but includes patients with different symptomatology [6, 14, 51, 59]. This issue of *heterogeneity* amongst NSLBP patients was considered by the International Forum on Primary Care Research on LBP in 1995 and again in 1997. A top research priority was established in identifying and classifying patients into more homogenous subgroups [12], and since then, various LBP

E. V. Billis (✉)
Department of Physiotherapy,
Technological Educational Institute (TEI) of Lamia,
Lamia, Fthiotida, Greece
e-mail: billis@teilam.gr

E. V. Billis
Centre for Rehabilitation Science,
University of Manchester, Manchester, UK

C. J. McCarthy
Emergency Care and Rehabilitation,
Warwick Medical School,
University of Warwick, Warwick, UK

J. A. Oldham
Wellcome Trust Clinical Research Facility,
University of Manchester, Manchester, UK

classification systems have been developed or used either for diagnostic or for treatment purposes [28, 32, 80]. Classification systems aim to identify clinical subgroups from the large NSLBP population by means of physical examination and clinical presentation criteria, specific questionnaires, or other diagnostic procedures [76]. For each assigned homogenous subgroup the response to specific therapeutic modalities can then be guided, facilitated or even further explored. This diagnostic procedure is, therefore, a critical step in attempting to deal with the heterogenous NSLBP population [14, 38, 51, 59, 80], which so far has not been found to respond to a particular treatment approach [14, 59]. Indeed, classification-based treatment for acute LBP patients has recently been proven to be superior to treatment based on clinical guidelines [37]. This literature review aims to critique the up-to-date classification systems.

However, when investigating the biopsychosocial nature of LBP, the impact of culture ought to be considered. Culture is defined as ‘a set of societal rules and standards developed over time and shared by the members of a particular society’ [35]. It appears that diagnostic procedures differ amongst different cultural settings [21, 84]. For example, radiographic procedures for LBP patients and clinical decision making among professionals differ across countries [2, 31]. Cross-country differences have also been found to exist in medical, physical and psychosocial findings as well as in the management across LBP sufferers of different cultural backgrounds [15, 82, 86, 98]. Studies from the USA have concluded that American LBP patients take more medication, experience more emotional and behavioral disturbance and are more dysfunctional compared to other cultures such as Japanese or New Zealanders [15, 17, 82]. Brena et al. [15], for example, compared Japanese and American LBP patients in their study, and attributed these findings to the fact that within Japan pain-related dysfunctions are more ‘concealed’ and less acceptable than in the more liberal American society. More importantly, the LBP has recently been characterized as a *culturally driven disorder* [1], thus, reinforcing the role that culture plays in the natural history of LBP. Even within similar cultural settings, socioeconomic differences can affect the presentation of LBP [90, 93].

Additionally, treatment decisions are not always based on an evidence-based clinical reasoning model, but quite often, are dictated by each country’s health system [9, 34, 83]. For example, Greek physiotherapists are only covered by health insurances for treating their patients and not for assessing them, or for deciding on treatment; these procedures are legally considered as medical ones [9]. Thus, ‘cultural’ issues have an impact on how LBP is managed. If such issues influence the presentation of pain across sufferers, the diagnosis and the clinical decision making of

health professionals across countries, it is not unreasonable to assume that diagnostic and treatment-based subgroup classification procedures would be affected, too. Thus, the aim of this critical appraisal is to perform a cross-country comparison of the up-to-date classification systems by addressing each country’s similarities and differences. A secondary aim of the study is to explore whether any cultural factors have been incorporated into the subclassification process.

Methods

A systematic search of the electronic databases Medline, Cinahl, AMED and PEDro between January 1980 and October 2005 was undertaken. The search terms used were low back pain, and classification combined with reliability, validity and outcome measures. The search was limited to adult human subjects, and the papers were selected provided that the title or abstract was relevant to the development or the use of a LBP classification system. In addition, two highly cited classification chapters from spinal textbooks have been included in this appraisal [5, 32]. Buchbinder et al. [16] in an attempt to describe and critique classification systems for the neck and upper limb, developed methodological criteria, which have been adopted in subsequent critical appraisals [66, 76, 80]. Buchbinder’s criteria have also been adapted to fit the needs of this study. Thus, this study’s descriptive elements include the study’s *Purpose*, *Country* detailing where the study took place, *Cultural Considerations* (i.e. the population’s culture, the culture of the system’s developer etc.), *Type of Research*, *Domain of interest* referring to the patient population (i.e. chronic, acute etc.), *Categories* referring to the number of primary and secondary categories the authors developed, *Discriminative criteria used* referring to the evaluating criteria used to distinguish between different categories (i.e. questionnaires, pain distribution patterns etc.), *Profession and Setting* referring to the professions involved in the development of the classification and the type of setting (i.e. outpatient clinic etc.), *Protocol* (how well-defined and comprehensible is), *Special training required* whether the clinicians involved required any special training, and *Method of development*, whether a judgment or a statistical approach has been used for the subgroup development. The criteria proposed by Buchbinder et al. [16] for critically appraising a classification system include *Purpose*, *Content Validity*, *Face Validity*, *Feasibility*, *Construct Validity*, *Reliability* and *Generalisability*. Another criterion has been added addressing the *Cultural Considerations* of each classification system, referring to whether any cultural factors have been taken into account in the subgroups’ process (such as

gender, language, education, occupation, religion, any social aspects etc.). A detailed description on what areas or questions should a classification system cover in order for each criterion to be met is given in Table 1.

Results

Classification systems from nine countries were identified: UK, France, Switzerland, Sweden, Denmark, Canada, USA, Australia and New Zealand. Three distinct classifying paradigms were identified: pathoanatomic and/or clinical features (*biomedical*), psychological and social/work features (*psychosocial*), and mixed biomedical and psychosocial features (*biopsychosocial*). An overview of the classification systems according to their paradigm and country is provided in Table 2. The majority of the selected studies (28 out of 39) were classified by biomedical paradigm, less studies (7) by psychosocial paradigm and only 4 utilized a biopsychosocial (mixed) approach. Several other reliability and validity studies of the reported systems have been included in the discussion as complementary to the reviewed papers. Tables 3, 4 and 5 provide the description of all papers classified according to a biomedical, psychosocial or mixed approach,

respectively. Table 6 reports the critical appraisal of all presented classification systems.

Discussion

Within Europe, five countries (UK, France, Denmark, Sweden and Switzerland) in total have developed their own classification systems with marked similarities and differences amongst them. In all except two European studies [57, 74] the profession involved in developing the classification systems was the medical profession; which could indicate the dominance of the ‘medical’ model throughout Europe [9]. Also most classification systems were *diagnostic* [5, 19–20, 74], and psychosocial questionnaires were one of the most commonly used discriminatory criteria for subgroup classification. In addition, several classification systems [7, 19–20, 48, 62, 88, 89] took into account one cultural factor, the sample’s primary language; they thus, have included in the classification process only patients that had the same primary language.

The biggest difference across the European systems was the classifying paradigm. Petersen et al. [74] proposed a classification based on pathoanatomic structures likely to be at fault, which has recently proven to have only

Table 1 Criteria used to appraise classification systems (adapted by Buchbinder et al. [16])

Criteria	Description
Purpose	Are the purpose and setting clearly specified?
Cultural considerations	Has the subjects’ culture being specified? Have any cultural factors been taken into account in the subclassification process? (i.e. inclusion/exclusion criteria)
Content validity	Is the domain and all specified exclusions from this domain clearly specified? Are all relevant categories included? Is the breakdown of categories appropriate, considering the purpose? Are the categories mutually exclusive? Was the method of development appropriate?
Face validity	If multi-axial, are criteria of content validity satisfied for each additional axis? Is the nomenclature used to label the categories satisfactory? Are the terms used based upon empirical (i.e. directly observable) evidence? Are the criteria for determining inclusion into each category clearly specified? If yes, do these criteria appear reasonable? Have the criteria been demonstrated to have validity and/or reliability? Are the definitions of criteria clearly specified? If multi-axial, are criteria of face validity satisfied for each additional axis?
Feasibility	Is classification simple to understand? Is classification easy to perform? Does it rely on clinical examination alone? Are special skills, tools, and/or training required? How long does it take to perform?
Construct validity	Does it discriminate between entities that are thought to be different in a way appropriate for the purpose? Does it perform satisfactorily when compared to other classification systems which classify the same domain?
Reliability	Does the classification system provide consistent results when classifying the same conditions (test–retest)? Is the intraobserver and interobserver reliability satisfactory?
Generalisability	Has it been used in other studies and/or settings?

Table 2 Overview of the classification systems according to country of study and classifying paradigm

Country of study	Classifying paradigm		
	Biomedical approach	Psychosocial approach	Biopsychosocial (mixed) approach
UK	Heinrich et al. [43], Barker [5], Langworthy and Breen [57]	Main et al. [62]	–
France	Coste et al. [19, 20]	Ozguler et al. [73]	–
Sweden	–	Bergstrom et al. [7, 8]	–
Denmark	Petersen et al. [74]	–	–
Switzerland	–	–	Stiefel et al. [88, 89], Huyse et al. [48]
Canada	Spitzer et al. [87], Binkley et al. [10], Moffroid et al. [68], Wilson et al. [103]	–	–
Australia	Sikorski [85], Kent and Keating [52]	Strong et al. [91, 92]	Harper et al. [41], O'Sullivan [72]
New Zealand	McKenzie [67], Laslet and van Widjem [58]	–	–
USA	Mooney [69], DeRosa and Porterfield [26], Rezaian et al. [79], Delitto et al. [25], Fardon [32], Marras et al. [65], Newton et al. [70], O'Hearn [71], BenDebba et al. [6], Fritz et al. [36], VanDillen et al. [96, 97], Werneke and Heart [101], George and Delitto [39]	Keefe et al. [50], Krause and Ragland [56], Klapow et al. [54, 55]	–

acceptable reliability and poor screening ability [75]. Main et al. [62] from UK, Bergstrom et al. [7] from Sweden, and Ozgugler et al. [73] from France utilized a psychosocial approach. Finally, Stiefel et al. [88, 89] and Huyse et al. [48] managed to integrate *biopsychosocial* features into patient subgroups. Unfortunately, their classification has not been utilized by others (in Switzerland or abroad) and thus has limited evidence of generalisability. The chronic LBP subgroups of Bergstrom et al. [7] partially established predictive validity in another Swedish study [8] where rehabilitation was involved; however, improvement did not differ across subgroups. Hutten and Hermens [47] from the Netherlands used lumbar dynamometry and psychosocial measures to classify chronic LBP patients, and based on treatment outcomes across subgroups, they recommend the combination of these instruments for treatment guidance. A recent UK study by Dunn and Croft [30] used a single question on 'bothersomeness' and psychosocial measures to classify LBP patient in primary care. Interestingly, this simple question proved to be a valid measure of severity.

Contrary to the European systems, most Australian classification systems are *treatment-based* (rather than diagnostic), no studies considered any cultural factors, and the professions developing the systems varied from physiotherapists [72] and occupational therapists [91], to doctors [85] and multi-disciplinary teams [41, 52]. Another difference is the classifying paradigms, as psychosocial [91], biopsychosocial [41], pathoanatomic and clinically based features [52, 85] have been utilized. A newly developed three-subgroup system [72] utilizes a

biopsychosocial approach and classified chronic LBP patients according to the underlying mechanism of dysfunction (either adaptive, maladaptive or behavioral driven motor impairment groups). Although reliability was high amongst two expert clinicians, a sample of clinical physiotherapists demonstrated only moderate reliability in classifying patients [23]. With the exception of a study by Strong et al. [91], where nearly 6 out of 8 methodological criteria were met, all other studies were developed judgmentally and more than half of the appraising criteria set by this study were not met. A study by Kent and Keating [52] appears to be representative of Australian health professionals; primary care clinicians from six disciplines were asked to identify NSLBP clinical subgroups via postal surveys with however, no consensus amongst clinicians being reached.

New Zealand LBP sufferers are reported to have lower levels of psychosocial, behavioral and physical findings than other cultures, such as the Americans [17, 82, 94]. Two biomedically classified systems are found in New Zealand, one of which, the McKenzie classification system [67], is by far the most internationally used system. Reliability studies have been conducted in Finland [53] and America [27, 81] with variable results. However, what makes McKenzie classification so popular is its predictive ability and validity with certain pain pattern features, such as the centralization phenomenon [29, 49, 99, 100], repetitive and lateral shift movements [63, 95]. However, despite a recent Canadian randomized controlled trial supporting McKenzie's system [61], more large-scale

Table 3 Classification systems based on biomedical approach (pathoanatomic and/or clinical features)

Study/country of study	Purpose	Cultural considerations	Type of research/method of development	Domain of interest/classifying categories	Discriminative criteria used	Profession/setting	Protocol/special training required
Heinrich et al. [43]/UK	To develop an empirically defined diagnostic classification system	Not specified	Prospective clinical study/statistical	NSLBP/7 categories	Selected signs and symptoms (from both history and clinical presentation) which derived from a large NSLBP group	Medical/back pain (hospital) clinic	Complicated methodology/ requiring advanced statistical skills
Barker [5]/UK	To develop a classification for LBP which would facilitate GPs ^b	Not specified	Prospective clinical study/judgment	LBP/6 categories	History and clinical presentation	Medical (GPs)/GP practice	Defined/no
Langworthy and Breen [57]/UK	To develop a classification system	Not specified	Clinical trial/statistical	LBP/2 categories	History and clinical presentation	Chiropractic/ chiropractic and orthopaedic clinics	Complicated methodology/ no
Coste et al. [19, 20]/France	To develop a classification for NSLBP	Excluded from sample non-French speaking patients	Clinical trial/statistical	NSLBP without psychiatric disorder/7 categories	History, physical examination and psychiatric interview	Medical (rheumatology)/ outpatient clinic	Defined/no
Petersen et al. [74]/Denmark	To propose a pathoanatomic-based classification	Not applicable	Literature review/judgment	NSLBP/13 categories/3 subcategories in one category	History and clinical examination	Physiotherapy/not applicable	Defined/ requiring training in McKenzie assessment
Sikorski [85]/Australia	To classify into groups for treatment	Not specified	Clinical trial/judgment	LBP including nerve root pain/7 categories	History, clinical presentation and radiographs	Medical/not specified	Not well/no
Kent and Keating [52]/Australia	To explore signs and symptoms that clinicians believe are representative of LBP subgroups	Australian health professionals from 6 disciplines	Large scale postal survey conducted to clinicians from 6 disciplines/statistical following survey analysis	Non-specific LBP/3 categories developed	Survey sent to clinicians containing 5 questions on non-specific LBP subgroups	Multi-disciplinary/not applicable	Yes/no
McKenzie [67]/New Zealand	To develop a treatment-guided classification system	Not specified	Proposal by an expert/judgment	LBP/4 categories (with additional subcategories in 2 categories)	History, clinical presentation and physical examination	Physiotherapy/ outpatient clinic	Well defined/ requiring a McKenzie trained therapist
Laslet and van Wijmen [58]/New Zealand	To propose a pathoanatomic based classification to guide treatment	Not applicable	Proposal of a model for classification/judgment	NSLBP/12 including some subcategories in some primary categories	History, clinical presentation and physical examination	Physiotherapy/not applicable	Defined/no

Table 3 continued

Study/country of study	Purpose	Cultural considerations	Type of research/method of development	Domain of interest/classifying categories	Discriminative criteria used	Profession/setting	Protocol/special training required
Spitzer et al. [87]/ Canada	To propose a diagnostic, prognostic and clinical decision guided classification system	Not specified	Clinical trial/judgment	LBP/Quebec Task Force Classification (QTFC): 11 primary categories and 2 secondary ones	History, clinical presentation and medical investigations	Multi-disciplinary team/clinics	Well defined/no
Binkley et al. [10]/ Canada	To develop LBP subgroups based on agreement levels across PTs ^c	English-speaking PTs (including Australia, USA, Canada and New Zealand)	Delphi survey search conducted amongst 30 expert orthopaedic physiotherapists/judgment	LBP/19	History, clinical presentation and medical investigations (blood tests and radiographs)	Physiotherapy/not applicable	Defined/ requiring expert PTs (meeting a set of specific criteria)
Moffroid et al. [68]/ Canada	To identify LBP subgroups based on NIOSH (low back atlas) physical measures	Caucasian sample	Clinical trial/statistical	LBP/4 categories	Physical examination, history, clinical presentation, questionnaires on disability and psychological health	Physiotherapy/7 different settings	Defined/yes
Wilson et al. [103]/ CANADA	To explore the intertester reliability of a LBP classification system	Not specified	Reliability study/judgment	LBP of mechanical origin/6 categories	History, clinical presentation and physical examination	Physiotherapy/10 back clinics	Well defined/ more than half of the PTs were highly experienced
Mooney [69]/USA	To propose a classification system	Not applicable	Literature review (point of view)/judgment	LBP/3 categories	Clinical presentation	Medical (orthopaedic)/not applicable	Not analyzed sufficiently/not specified
De Rosa & Porterfield [26]/ USA	To propose a classification system to guide treatment	Not applicable	Proposal of a classification model/judgment	LBP/7categories (based on the QTFC)	History and clinical examination	Physiotherapy/not applicable	Not well defined /nNot specified
Rezaian et al. [79]/ USA	To develop a practical LBP classification system	Not specified	Clinical trial/judgment	LBP/5 categories	History, clinical presentation and some investigations (X-rays etc.)	Medical (orthopaedic)/not specified	Not well established/not specified
Delitto et al. [25]/ USA	To propose a treatment based classification system	Not applicable	Proposal based on initial pilot study (including PTs, chiropractors and physicians)/judgment	LBP/3 categories (following an initial category determining if physiotherapy is indicated)/2 subcategories	History, clinical presentation and some physical tests	Physiotherapy/not specified	Well defined/not specified

Table 3 continued

Study/country of study	Purpose	Cultural considerations	Type of research/method of development	Domain of interest/classifying categories	Discriminative criteria used	Profession/setting	Protocol/special training required
Fardon [32]/USA	To critique existing classification systems and discuss a classification procedure where certain syndromes (specific and 'semispecific') fall in	Not applicable	Proposal of a classification procedure based on literature review of three existing classification systems (QTF, ICD ^e and NASS ^b)/judgment	LBP/3 principal categories/several subcategories within each category	History, clinical presentation, physical tests and investigations in some subcategories	Medical (orthopaedic)/not applicable	Defined/not specified
Marras et al. [65]/USA	To determine whether trunk motion measures could classify LBP patients	Not specified	Clinical trial/judgment	Chronic LBP/10 of the 11 QTFC categories	Clinical presentation, medical investigations and trunk motion measures (utilizing specific apparatus)	Medical/not reported	Complicated/not reported
Newton et al. [70]/USA	To explore the prevalence of an already developed taxonomy of LBP sub-types	Not specified	Clinical trial/judgment	LBP (mainly acute& sub acute)/17 categories (12 of which were considered rare)	History, clinical presentation and physical examination	Multi-disciplinary/not defined	Defined/no
O'Hearn [71]/USA	To report the outcomes from a modified QTFC	Not specified	Clinical study/judgment	LBP/9 modified QTFCs/2 subcategories	History, physical examination& investigations	Physiotherapy/Physiotherapy clinic	Defined/No
BenDebba et al. [6]/USA	To assign chronic LBP patients to 1 of 4 slightly modified QTFCs	Not specified	Clinical trial/judgment	Chronic (persistent) LBP/4 (based on the first four QTFCs)	Pain, functional& psychological questionnaires, SLR ^d examination, imaging investigations	Medical (physicians)/8 university-affiliated tertiary care clinics	Defined/no
Fritz et al. [37]/USA	To compare classification based with clinical guidelines' induced physiotherapy	Not specified	Randomized clinical trial/judgment	Acute work-related LBP/4 categories (based on Delitto's classification)	Clinical presentation and physical examination (for reported measures (for measuring outcomes)	Physiotherapy/9 outpatient clinics	Well defined/yes
Van Dillen et al. [96, 97]/USA	To assess the reliability and the validity of a LBP movement impairment classification system	Not specified	Reliability (1998) and cross-sectional clinical study (2003)/judgment	Mechanical LBP/5	Clinical presentation (symptom behavior) and physical examination	Physiotherapy/outpatient clinics	Well defined/yes
Werneke and Hart [101]/USA	To assess the validity of a modified QTFC and a pain pattern classification (PPC)	English-speaking patients	Clinical trial/judgment	Acute work-related LBP/QTFC 1–4 (merged 1 with 2 categories, and 3 with 4), PPC of 2	Clinical presentation, physical examination and various functional and psychosocial questionnaires	Physiotherapy/outpatient clinics	Well defined/yes (McKenzie-trained PTs)

Table 3 continued

Study/country of study	Purpose	Cultural considerations	Type of research/method of development	Domain of interest/classifying categories	Discriminative criteria used	Profession/setting	Protocol/special training required
George and Delitto [39]/USA	To explore if examination variables discriminate amongst treatment-based classification	Not specified	Clinical study/judgment	Acute LBP/4 treatment-based categories (TBC) by Delitto's classification	Clinical presentation and physical examination	Physiotherapy/not specified	Well defined/yes (trained for the TBC system)

^a Non-specific low back pain

^b General practitioners

^c Physiotherapists

^d Straight leg raise

^e International classification of diseases

^f North American Spine Society

studies with longer follow-ups are needed for determining its effectiveness [24].

Canadian studies have all used a biomedical approach and have classified all LBP patients (acute, subacute and chronic). In one study [10] one cultural factor (language) was considered. All but one study [87] were developed by physiotherapists, and all studies, except one [68], were developed by a judgmental approach from the proposed authors; thus, methodological quality has been low in most of them. Spitzer et al. [87] present one of the most popular systems developed by a multi-disciplinary team of LBP experts for diagnosis, treatment guidance and prognosis. The system comprises 11 categories known as the Quebec Task Force (QTF) categories. Although several American studies have adopted this classification [4, 6, 32, 65, 71], predictive validity has not been established in all categories [4, 60]. No study has explored the reliability of the QTF system, thus limiting its generalisability.

The USA has the highest number of published reports on socio-economic, psychosocial and cultural issues that appear to influence LBP management. In a series of cross-cultural comparative studies between Americans and other cultures (Japanese, Mexican, New Zealanders etc.), American citizens appeared to have more dysfunction, psychosocial, emotional and behavioral impairments, as well as financial compensation issues compared to the other cultural groups [15, 17, 82]. The USA has the biggest number of published reports on classification systems, most of which are classified by biomedical features.

In nearly all USA studies some form of clinical examination is included; compared to the questionnaire-based approaches adopted by most European studies. Like most other systems, only one study [101] took into account a cultural factor (language). Three biomedically-based classification systems have received considerable attention in the literature; the Delitto's classification system [25, 36, 38, 39, 44], the McKenzie's system [29, 81, 95, 100, 101] and the QTF classification system [4, 6, 32, 65, 71]. However, none of the three has exceptionally good inter-tester reliability.

Finally, three studies have developed clinical prediction rules made up of clinical examination items and psychosocial/disability questionnaire scores in order to identify one group profile from the NSLBP sample which would respond to a particular treatment. In two of the studies, a prospective cohort [33] and a multi-centre controlled trial [18], the same prediction rule has been utilized for identifying patients likely to respond to spinal manipulation, whereas Hicks et al. [46] utilized a prediction rule for identifying patients likely to respond to a stabilization exercise programme. All three studies verified that their patient subgroup was accurately identified demonstrating short- and mid-term improvements with

Table 4 Classification systems based on a psychosocial approach

Study/country of study	Purpose	Cultural considerations	Type of research/ method of development	Domain of interest/classifying categories	Discriminative criteria used	Profession/ setting	Protocol/special training required
Main et al. [62]/UK	To develop a simple LBP classification based on measures of distress	English had to be the first language of the subjects	Clinical trial/statistical (cluster analysis)	LBP/4	Questionnaires and clinical presentation	Medical (orthopaedic)/ orthopaedic departments	Defined but complicated/no
Ozguler et al. [73]/France	To provide a practical LBP classification utilizing a specific questionnaire	Not specified	Clinical trial/statistical (cluster analysis)	Chronic LBP patients at work/4	Questionnaires (measuring functional, emotional and fear related parameters)	Medical/not specified	Defined/no
Bergstrom et al. [7, 8]/Sweden	To identify chronic LBP subgroups	Fluency in the Swedish language	Clinical study/statistical	NSLBP of chronic phase/4	Questionnaires (measuring psycho-social and behavioral parameters)	Medical (psychology)/ multi-centre clinics	Defined/no
Strong et al. [91, 92]/Australia	To integrate 6 dimensions of LBP into one (multi-dimensional)	Not specified	Clinical study/statistical (cluster analysis)	Chronic LBP/3	Questionnaires (measuring pain, function, coping, depression, illness, behavior etc.)	Occupational therapy/not specified	Defined/no
Keefe et al. [50]/USA	To classify based on observed pain behavior	Not specified	Clinical study/statistical (cluster analysis)	Chronic LBP/4	Observed pain behavior (during specific activities)	Medical (psychiatry)/pain management programme	Defined/yes (training on observation)
Krause and Ragland [56]/USA	To propose a classification system for occupational LBP based primarily on social factors	Not applicable	Review and proposal of a new classification system/judgment	Occupational LBP/8	Working status, insurance policies (compensation) and medical status	Epidemiology/not applicable	Defined/no
Klapow et al. [54, 55]/USA	To explore social variables among LBP subgroups	Caucasian men	Clinical trial/statistical	Chronic LBP/3 existing categories (Klapow et al. [54])	Questionnaires measuring psychosocial variables (life adversity, coping, social support)	Medical/primary care orthopaedic clinic	Defined (classified in Klapow et al. [54])/no

Table 5 Classification systems based on a biopsychosocial (mixed) approach

Study/country of study	Purpose	Cultural considerations	Type of research/ method of development	Domain of interest/classifying categories	Discriminative criteria used	Profession/ setting	Protocol/special training required
Stiefel et al. [88, 89] Huyse et al. [45]/ Switzerland	To develop a classification system based on bio-psychosocial factors and on “case complexity”	French speaking patients	Cross-sectional study/ judgmental in development and statistical in testing for subgroups	Chronic LBP/4	History and specific questioning in 4 domains (biologic, psychological, social and health care)	Medical/in and outpatients	Defined/no
Harper et al. [41]/Australia	To develop a taxonomy that takes into account impairment, disability and handicap resulting from LBP	Not specified	Clinical trial/judgment	Occupational LBP of chronic nature/2 categories on primary impairments, 12 on secondary ones and 5 tertiary ones on handicap	Interviews and questionnaires	Multi-disciplinary/ not specified	Defined/no
O’Sullivan [72]/Australia	To develop a classification system based on motor control impairment	Not applicable	Proposal of a classification system based on up to date review/judgment	Chronic LBP/3	History, clinical presentation, physical examination and questionnaires (disability and fear-avoidance)	Physiotherapy/ not applicable	Defined/not reported

their treatments. These reports could further improve the accuracy and success of treatment guided classification systems should they be incorporated into an existing classification system.

Limitations of the current classification studies

The majority of the classification studies were developed using a judgmental approach. Thus, the systems have been based on a small sample of clinicians and relied on their personal clinical experience. It can be argued that this method of development is likely to be biased and thus may not represent a system that can be generalized well to the clinical community as a whole. The statistical approach is considered superior to the judgmental, as categories can be developed prospectively, based on the outcomes of discriminatory criteria, and thus, author bias is reduced.

Reliability has been addressed (with moderate success) in some studies; it is however crucial to ensure agreement on the outcome of a classification process amongst clinicians. Further, adequately powered, reliability studies are needed. Content validity is important for providing unique and mutually exclusive categories, and in most studies it has only been partially met as the multi-dimensional biopsychosocial aspects of LBP have not been addressed. It is suggested that a *bio-psycho-social* approach should be included in classifying LBP patients, to satisfy content validity [13, 66].

Despite the fact that cross-cultural differences have been documented to exist between LBP sufferers [15, 82] very few studies included any cultural factors in their sub-classification process (other than the language factor within bilingual or multi-lingual countries). It may be that cultural issues are neglected because of a difficulty in objectively measuring cultural impact [35, 45]. Alternatively, it may be due to a lack of sufficient cultural information relating to the diagnosis, prognosis or LBP management. For example, although LBP researchers acknowledge that there are influences of sociocultural factors (such as the patients’ behavior and beliefs, psychosocial factors, economic and compensation status, type of occupation etc.) in the diagnosis, future management and, prognosis of the condition [40, 78, 90, 102], this information cannot yet be sufficiently quantified. Thus, important cultural factors in LBP classification remain inadequately explored.

Recommendations

It is interesting to note that whilst there has been considerable interest in developing a uniform classification approach, across many cultures, no system has become universally adopted. When examining the disparities and

Table 6 Summary of critical appraisal of classification systems

Biomedical approach	Purpose	Cultural considerations	Content validity	Face validity	Feasibility	Construct validity	Reliability	Generalisability
UK								
Heinrich et al. [50]	Yes	No	No	Partial	No	No	No	No
Barker [5]	Yes	No	Partial	No	Yes	No	No	No
Langworthy and Breen [57]	Yes	No	No	No	No	No	No	No
France								
Coste et al. [19, 20]	Yes	Partial	Partial	Partial	Partial	No	No	No
Denmark								
Petersen et al. [74]	Yes	No	Partial	Partial	Partial	No	Partial	Partial
Australia								
Sikorski [85]	Yes	No	No	No	Partial	No	No	No
Kent and Keating [52]	Yes	Partial	Partial	Partial	Not applicable	Not applicable	Not applicable	Not applicable
New Zealand								
McKenzie [67]	Yes	No	Partial	Partial	Yes	Yes	Partial	Yes
Laslet and van Widjmen [58]	Yes	Not applicable	Partial	Partial	Partial	No	No	Partial
Canada								
Spitzer et al. [87]	Yes	No	Partial	Yes	Partial	Partial	Partial	Yes
Binkley al. [10]	Yes	Partial	Partial	Partial	Partial	No	No	No
Moffroid et al. [68]	Yes	Partial	Partial	Partial	Partial	No	No	Not known
Wilson et al. [103]	Yes	No	Partial	Partial	Yes	No	Partial	No
USA								
Mooney [69]	Yes	No	No	No	Partial	No	No	No
De Rosa and Porterfield [26]	Yes	No	Partial	Partial	Yes	No	No	Not known
Rezaian et al. [79]	Yes	No	Partial	Partial	Partial	No	No	No
Delitto et al. [25]	Yes	No	Partial	Partial	Yes	No	No	Partial
Fardon [32]	Yes	Not applicable	Partial	Partial	Yes	No	No	Partial
Marras et al. [65]	Yes	No	Partial	Partial	No	No	Partial	No
Newton et al. [70]	Yes	No	Partial	Partial	Partial	No	No	No
O'Hearn [71]	Yes	No	Partial	Partial	Partial	Partial	No	No
BenDebba et al. [6]	Yes	No	Yes	Partial	Partial	No	No	No
Fritz et al. [37]	Yes	No	Partial	Partial	Yes	No	No	No
Van Dillen et al. [96, 97]	Yes	No	Partial	Partial	Yes	Partial	Partial	Partial
Werneke and Hart [101]	Yes	Partial	Partial	Yes	Partial	No	Partial	Partial
George and Delitto [39]	No	No	Partial	Partial	Yes	Partial	No	Partial
Psychosocial approach								
UK								
Main et al. [62]	Yes	Partial	Yes	Yes	Yes	No	Partial	Yes
Frances								
Ozguler et al. [73]	Yes	No	Yes	Yes	Yes	No	Partial	No
Sweden								
Bergstrom et al. [7, 8]	Yes	Partial	Yes	Yes	Yes	No	Partial	Yes
Australia								
Strong et al. [91, 92]	Yes	No	Yes	Yes	Yes	No	Partial	Yes
USA								
Keefe et al. [50]	Yes	No	Yes	Yes	Partial	Partial	Partial	Partial

Table 6 continued

Biomedical approach	Purpose	Cultural considerations	Content validity	Face validity	Feasibility	Construct validity	Reliability	Generalisability
Krause and Ragland [56]	Yes	No	Partial	Yes	No	No	No	No
Klapow et al. [54, 55]	Yes	Partial	Yes	Yes	No	No	Yes	Yes
Bio-psychosocial (mixed) approach								
Switzerland								
Stiefel et al. [88, 89], Huyse et al. [48]	Yes	Partial	Yes	Yes	Yes	Partial	Yes	Partial
Australia								
Harper et al. [41]	Yes	No	Partial	Yes	Partial	No	No	No
O'Sullivan [72]	Yes	Not applicable	Partial	Partial	Yes	No	Partial	No

similarities across different country's classifications, some conclusions can be made. Firstly, when dealing with NSLBP diagnostic classification procedures, the psychosocial as well as the biomedical profile of the patients should be taken into account. From the classification literature it is clear that both these clinical aspects of the patient's profile should be evaluated in order to subclassify NSLBP patients with a strong degree of content validity.

Secondly, there are a few diagnostic classification systems (such as the QTF [87]) as well as a few treatment-based classifications (McKenzie [67]) that have a degree of external validity and reliability and can therefore, be recommended for usage for diagnostic or therapeutic purposes. However, as highlighted previously, it is important to incorporate both dimensions (biomedical and psychosocial) in the classifying process. Thus, these systems could be further improved by incorporating the dimensions that are missing. For example, the McKenzie or the QTF classification system (which both follow the biomedical paradigm) could incorporate some psychosocial elements in their classification procedure from the higher quality psychosocial classification studies [7, 48, 54, 55, 89, 91] as well as clinical prediction rule studies [18, 46], and explore again the efficiency of this improved system amongst an NSLBP sample.

Thirdly, incorporating cultural factors into the subclassification process, would be enlightening. By considering factors, such as the structure of the health system within a country, the availability of the health system in obtaining diagnosis and treatment and general societal beliefs regarding LBP, it is not unreasonable to assume that specific clinical 'patterns' could be emerging within a given country, which could be useful for the diagnostic practice and the clinical decision making of LBP subgroups.

Finally, an international expert meeting where the problem of LBP classification is brought to light, and dissemination of findings takes place could perhaps be a

starting point for obtaining a more definite consensus for this problem in order to have a common platform for all researchers, instead of approximately 40 different classification systems today.

Conclusions

It appears that, despite the plethora of studies developing classification systems, yet again, a question remains "why hasn't any system been internationally established or successful?" The answer to this could lie on the fact that most systems address only one dimension of LBP presentation (i.e. biomedical or psychological), while there is evidence supporting a biopsychosocial LBP presentation. Additionally, despite the fact that cultural factors are not yet taken into consideration in classification studies, it appears that there are some trends within countries. It may be, that the cultural setting may have an impact on the natural history of LBP and thus it would seem sensible for health professionals to complement their biomedical assessment with an evaluation of the psychosocial and cultural aspects of their patients i.e. their attitudes, beliefs, interactions etc. which seem to be driving the history of the condition. Future research should aim to develop and explore further some of the existing LBP classification systems (the ones that score the highest methodological quality) by, addressing the sociocultural factors of the classified sample.

References

1. Aceves-Avila FJ, Ferrari R, Ramos-Remus C (2004) New insights into culture driven disorders. *Best Pract Clin Res Rheumatol* 18:155–171
2. Ammendolia C, Bombardier C, Hogg-Johnson S et al (2002) Views on radiography use for patients with acute low back pain among chiropractors in an Ontario community. *J Manipulative Physiol Ther* 25:511–520

3. Andersson GB (1998) Epidemiology of low back pain. *Acta Orthop Scand Suppl* 281(69):28–31
4. Atlas SJ, Deyo RA, Patrick DL, et al (1996) The Quebec Task Force classification for Spinal Disorders and the severity, treatment, and outcomes of sciatica and lumbar spinal stenosis. *Spine* 21:2885–2892
5. Barker ME (1990) A practical classification of spinal pains based on a study of patients seen in British general practice over a five-year period. In: Fairbank JCT, Pynsent PB (eds) *Back pain: classification of syndromes*. Manchester University Press, Manchester, pp 23–36
6. BenDebba M, Torgerson WS, Long DM (2000) A validated, practical classification procedure for many persistent low back pain patients. *Pain* 87:89–97
7. Bergstrom G, Bodin L, Jensen IB et al (2001a) Long-term, non-specific spinal pain: reliable and valid subgroups of patients. *Behav Res Ther* 27:1783–1789
8. Bergstrom G, Jensen IB, Bodin L et al (2001b) The impact of psychologically different patient groups on outcome after a vocational rehabilitation program for long-term spinal pain patients. *Pain* 93:229–237
9. Billis EV, McCarthy CJ, Stathopoulos I et al (2006) The clinical and cultural factors in classifying low back pain patients within Greece: a qualitative exploration of Greek health professionals. *J Eval Clin Pract* (in press)
10. Binkley J, Finch E, Hall J et al (1993) Diagnostic classification of patients with low back pain: report on a survey of physical therapy experts. *Phys Ther* 73:138–150
11. Borenstein DG (1999) Epidemiology, etiology, diagnostic evaluation, and treatment of low back pain. *Curr Opin Rheumatol* 11:151–157
12. Borkan JM, Koes B, Reis S et al (1998) A report from the second international forum for primary care research on low back pain. *Spine* 23:1992–1996
13. Borkan J, Van Tulder M, Reis S et al (2002) Advances in the field of low back pain in primary care. A report from the fourth international forum. *Spine* 27:E128–E132
14. Bouter LM, Van Tulder MW, Koes BW (1998) Methodologic issues in low back pain research in primary care. *Spine* 23:2014–2020
15. Brena SF, Sanders SH, Motoyama H (1990) American and Japanese chronic low back pain patients: cross-cultural similarities and differences. *Clin J Pain* 6:118–124
16. Buchbinder R, Goel VK, Bombardier C et al (1996) Classification systems of soft tissue disorders of the neck and upper limb: Do they satisfy methodological guidelines? *J Clin Epidemiol* 49:141–149
17. Carron H, DeGood DE, Tait R (1985) A comparison of low back pain patients in the United States and New Zealand: psychosocial and economic factors affecting severity of disability. *Pain* 21:77–89
18. Childs MJ, Fritz JM, Flynn TW et al (2004) A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: A validation study. *Ann Intern Med* 141:920–928
19. Coste J, Paolaggi JB, Spira A (1992) Classification of nonspecific low back pain. I. Psychological involvement in low back pain. A clinical, descriptive approach. *Spine* 17:1028–1037
20. Coste J, Paolaggi JB, Spira A (1992) Classification of nonspecific low back pain. II. Clinical diversity of organic forms. *Spine* 17:1038–1042
21. Cristiaens T, De Backer D, Burgers J et al (2004) Guidelines, evidence, and cultural factors. Comparison of four European guidelines on uncomplicated cystitis. *Scand J Prim Health Care* 22:141–145
22. CSAG. Clinical standards advisory group back pain (1994) HMSO, London
23. Dankaerts W, O'Sullivan PB, Straker LM et al (2006) The inter-examiner reliability of a classification method for non-specific chronic low back pain patients with motor control impairment. *Man Ther* 11:28–39
24. Delaney PM, Hubka MJ (1999) The diagnostic utility of McKenzie clinical assessment for lower back pain. *J Manipulative Physiol Ther* 22:628–630
25. Delitto A, Erhard R, Bowling RW (1995) A treatment-based classification approach to low back syndrome: identifying and staging patients for conservative treatment. *Phys Ther* 75:470–489
26. DeRosa CP, Porterfield JA (1992) A physical therapy model for the treatment of low back pain. *Phys Ther* 72:261–269
27. Donahue MS, Riddle DL, Sullivan MS, et al (1996) Interrater reliability of a modified version of McKenzie's lateral shift assessments obtained on patients with low back pain. *Phys Ther* 76:706–726
28. Donelson R (2004) Evidence-based low back pain classification. Improving care at its foundation. *Eura Medicophys* 40:37–44
29. Donelson R, Aprill C, Medcalf R et al (1997) A prospective study of centralization of lumbar and referred pain: a predictor of symptomatic discs and annular competence. *Spine* 22:1115–1122
30. Dunn KM, Croft PR (2005) Classification of low back pain in primary care: using 'bothersomeness' to identify the most severe cases. *Spine* 30:1887–1892
31. Espeland A, Baerheim A (2003) Factors affecting general practitioners' decisions about plain radiography for back pain: implications for classification of guideline barriers—a qualitative study. *BMC Health Serv Res* 3:1–10
32. Fardon DF (1997) Differential diagnosis of low back disorders. Principles of classification. In: Frymoyer JW (ed) *The adult spine. principles and practice*, 2nd edn. Lippincott-Raven Publishers, Philadelphia, vol 2, pp 1745–1768
33. Flynn T, Fritz J, Whitman J et al (2002) A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with spinal manipulation. *Spine* 27:2835–2843
34. Freburger JK, Karey TS, Holmes GM (2005) Physician referrals to physical therapists for the treatment of spine disorders. *Spine* 30:530–541
35. Free MM (2002) Cross-cultural conceptions of pain and pain control. *BUMC Proc* 15:143–145
36. Fritz JM (1998) Use of a classification approach to the treatment of 3 patients with low back syndrome. *Phys Ther* 78:766–777
37. Fritz JM, Delitto A, Erhard RE (2003) Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain. *Spine* 28:1363–1372
38. Fritz JM, George S (2000) The use of a classification approach to identify subgroups of patients with acute low back pain. Interrater reliability and short-term treatment outcomes. *Spine* 25:106–114
39. George SZ, Delitto A (2005) Clinical examination variables discriminate among treatment-based classification groups: a study of construct validity in patients with acute low back pain. *Phys Ther* 85:306–314
40. Goubert L, Crombez G, De Bourdeaudhuij I (2004) Low back pain, disability and back pain myths in a community sample: prevalence and interrelationships. *Eur J Pain* 8:385–394
41. Harper AC, Harper DA, Lambert LJ et al (1992) Symptoms of impairment, disability and handicap in low back pain: a taxonomy. *Pain* 50:189–195

42. Hart LG, Deyo RA, Cherkin DC (1995) Physician office visits for low back pain: frequency, clinical evaluation, and treatment patterns from a US national survey. *Spine* 20:11–19
43. Heinrich I, O'Hare H, Sweetman B et al (1985) Validation aspects of an empirically derived classification for non-specific low back pain. *Statistician* 34:215–30
44. Heiss DG, Fitch DS, Fritz JM et al (2004) The interrater reliability among physical therapists newly trained in a classification system for acute low back pain. *J Orthop Sports Phys Ther* 34:430–439
45. Helman CG (2000) Cultural factors in epidemiology. In: Helman CG (ed) *Culture, health and illness*, 4th edn. Gutenberg Press, Malta, pp 218–229
46. Hicks GE, Fritz JM, Delitto A et al (2005) Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil* 86: 1753–1762
47. Hutten MMR, Hermens HJ (2001) Differences in treatment outcome between subgroups of patients with chronic low back pain using lumbar dynamometry and psychological aspects. *Clin Rehabil* 15:479–488
48. Huyse FJ, Lyons JS, Stiefel FC et al (1999) "INTERMED": a method to assess health service needs. I. Development and reliability. *Gen Hosp Psychiatry* 21:39–48
49. Karas R, McIntosh G, Hall H, et al (1997) The relationship between nonorganic signs and centralization of symptoms in the prediction of return to work for patients with low back pain. *Phys Ther* 77:354–360
50. Keefe FJ, Bradley LA, Crismon JE (1990) Behavioral assessment of low back pain: identification of pain behavior subgroups. *Pain* 40:153–160
51. Kent P, Keating J (2004) Do primary-care clinicians think that nonspecific low back pain is one condition? *Spine* 29:1022–1031
52. Kent P, Keating JL (2005) Classification in nonspecific low back pain: what methods do primary care clinicians currently use? *Spine* 30:1433–1440
53. Kilpikoski S, Airaksinen O, Kankaanpää M et al (2002) Interrater reliability of low back pain assessment using the McKenzie method. *Spine* 27:E207–E214
54. Klapow JC, Slater MA, Patterson TL et al (1993) An empirical evaluation of multidimensional clinical outcome in chronic low back pain patients. *Pain* 55:107–18
55. Klapow JC, Slater MA, Patterson TL et al (1995) Psychosocial factors discriminate multidimensional clinical groups of chronic low back pain patients. *Pain* 62:349–55
56. Krause N, Ragland DR (1994) Occupational disability due to low back pain: a new interdisciplinary classification based on a phase model of disability. *Spine* 19:1011–1120
57. Langworthy JM, Breen AC (1997) Rationalizing back pain: the development of a classification system through cluster analysis. *J Manipulative Physiol Ther* 20:303–310
58. Laslett M, van Wijmen P (1999) Low back and referred pain: diagnosis and a proposed new system of classification. *NZ J Physiother* 27:5–14
59. Leboeuf-Yde C, Lauritsen JM, Lauritzen T (1997) Why has the research for causes of low back pain largely been nonconclusive? *Spine* 22:877–881
60. Loisel P, Vachon B, Lemaire J et al (2002) Discriminative and predictive validity assessment of the Quebec Task Force classification. *Spine* 27:851–857
61. Long A, Donelson R, Fung T (2004) Does it matter which exercise? a randomized control trial of exercise for low back pain. *Spine* 29:2593–2602
62. Main CJ, Wood PLR, Hollis S et al (1992) The distress and risk assessment method. A simple patient classification to identify distress and evaluate the risk of poor outcome. *Spine* 17:42–52
63. Maluf KS, Sahrman SA, Van Dillen LR (2000) Use of a classification system to guide nonsurgical management of a patient with chronic low back pain. *Phys Ther* 80:1097–1111
64. Maniadakis N, Gray A (2000) The economic burden of back pain in the UK. *Pain* 84:95–103
65. Marras WS, Parnianpour M, Ferguson SA et al (1995) The classification of anatomic- and symptom-based low back disorders using motion measure models. *Spine* 20:2531–2546
66. McCarthy CJ, Arnall F, Strimpakos N et al (2004) The biopsychosocial classification of non-specific low back pain: a systematic review. *Phys Ther Rev* 9:17–30
67. McKenzie R (1981) Subgroups in non specific spinal disorders. In: McKenzie R (ed) *The lumbar spine: mechanical diagnosis and therapy*. Spinal Publications Limited, Waikanae, pp 34–37
68. Moffroid MT, Haugh LD, Henry SM et al (1994) Distinguishable groups of musculoskeletal low back pain patients and asymptomatic control subjects based on physical measures of the NIOSH Low Back Atlas. *Spine* 19:1350–1358
69. Mooney V (1989) The classification of low back pain. *Ann Med* 21:321–325
70. Newton W, Curtis P, Witt P et al (1997) Prevalence of subtypes of low back pain in a defined population. *J Fam Pract* 45:331–335
71. O'Hearn MA (1997) Physical therapy treatment of low back pain: A report of outcomes according to three types of patient classification. *J Rehabil Outcomes Meas* 1:23–31
72. O'Sullivan P (2005) Diagnosis and classification of chronic low back pain disorders: maladaptive movement and motor control impairments as underlying mechanism. *Man Ther* 10:242–255
73. Ozguler A, Gueguen A, Leclerc A et al. (2002) Using the Dallas Pain Questionnaire to classify individuals with low back pain in a working population. *Spine* 27:1783–1789
74. Petersen T, Laslett M, Thorsen H, et al (2003) Diagnostic classification of non-specific low back pain. A new system integrating patho-anatomic and clinical categories. *Physiother Theory Pract* 19:213–237
75. Petersen T, Olsen S, Laslett M et al (2004) Inter-tester reliability of a new diagnostic classification system for patients with non-specific low back pain. *Aust J Physiother* 50:85–91
76. Petersen T, Thorsen H, Manniche C et al (1999) Classification of nonspecific low back pain: a review of the literature on classification systems relevant to physiotherapy. *Phys Ther Rev* 4:265–281
77. Picavet HJS, Schouten JSAG (2003) Musculoskeletal pain in the Netherlands: prevalences, consequences and risk groups, the DMC₃-study. *Pain* 102:167–178
78. Pincus T, Burton AK, Vogel S et al (2002) A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *Spine* 27:E109–E120
79. Rezaian SM, Spector IM, Collins A (1993) A new clinical classification of low back pain: a practical guide for diagnosing etiology by patient history. *J Neurol Orthop Med Surg* 14:205–209
80. Riddle DL (1998) Classification and low back pain: a review of the literature and critical analysis of selected systems. *Phys Ther* 78:708–737
81. Riddle DL, Rothstein JM (1993) Interrater reliability of McKenzie's classifications of the syndrome types present in patients with low back pain. *Spine* 18:1333–1344
82. Sanders SH, Brena SF, Spier CJ et al (1992) Chronic low back pain patients around the world: cross-cultural similarities and differences. *Clin J Pain* 8:317–323
83. Schers H, Braspenning J, Drijver R et al (2000) Low back pain in general practice: reported management and reasons for not adhering to the guidelines in The Netherlands. *Br J Gen Pract* 50:640–644

84. Seller RH, Lobley M (1991) Efficient diagnosis of common complaints: a comparative study in the United States and England. *J Fam Pract* 33:41–46
85. Sikorski JM (1985) A rationalized approach to physiotherapy for low-back pain. *Spine* 10(6):571–579
86. Skovron ML, Szpalski M, Nordin M et al (1994) Sociocultural factors and back pain. A population-based study in Belgian adults. *Spine* 19:129–137
87. Spitzer WO, LeBlanc FE, Dupuis M (1987) Scientific approach to the assessment and management of activity related spinal disorders: report of the Quebec Task Force on Spinal Disorders. *Spine* 12:S16–S21
88. Stiefel FC, de Jonge P, Huyse FJ et al (1999a) “INTERMED”: a method to assess health service needs. II. Results on its validity and clinical use. *Gen Hosp Psychiatry* 21:49–56
89. Stiefel FC, de Jonge P, Huyse FJ et al (1999b) INTERMED—an assessment and classification system for case complexity. Results in patients with low back pain. *Spine* 24:378–384
90. Stranjalis G, Tsamandouraki K, Sakas DE et al (2004) Low back pain in a representative sample of Greek population. Analysis according to personal and socioeconomic characteristics. *Spine* 29:1355–1361
91. Strong J, Ashton R, Stewart A (1994) Chronic low back pain: toward an integrated psychosocial assessment model. *J Consult Clin Psychol* 62:1058–1063
92. Strong J, Large RG, Ashton R et al (1995) A New Zealand replication of the IPAM clustering model for low back patients. *Clin J Pain* 11:296–306
93. Szpalski M, Nordin M, Skovron ML et al (1995) Health care utilization for low back pain in Belgium. Influence of socio-cultural factors and health beliefs. *Spine* 20:431–442
94. Tait R, DeGood D, Carron H (1982) A comparison of health locus of control beliefs in low-back patients from the US and New Zealand. *Pain* 14:53–61
95. Tenhula JA, Rose SJ, Delitto A (1990) Association between direction of lateral lumbar shift, movement tests, and side of symptoms in patients with low back pain syndrome. *Phys Ther* 70:480–486
96. Van Dillen LR, Sahrman SA, Norton BJ et al (2003) Movement system impairment-based categories for low back pain: stage 1 validation. *JOSPT* 33:126–142
97. Van Dillen LR, Sahrman SA, Norton BJ et al (1998) Reliability of physical examination items used for classification of patients with low back pain. *Phys Ther* 78:979–988
98. Waddell G (1998) The problem, social interactions, treatment: the scientific evidence. In: Waddell G (ed) *The back pain revolution*. Churchill Livingstone, Edinburgh, pp 1–8, 204–205, 265–267
99. Werneke M, Hart DL (2001) Centralization phenomenon as a prognostic factor for chronic low back pain and disability. *Spine* 26:758–765
100. Werneke M, Hart DL (2003) Discriminant validity and relative precision for classifying patients with non-specific neck and back pain by anatomic pain patterns. *Spine* 28:161–166
101. Werneke MW, Hart DL (2004) Categorizing patients with occupational low back pain by use of the Quebec Task Force classification system versus pain pattern classification procedures: discriminant and predictive validity. *Phys Ther* 84:243–254
102. Werner EL, Ihlebaek C, Skouen JS et al (2005) Beliefs about low back pain in the Norwegian general population: are they related to pain experiences and health professionals? *Spine* 30:1770–1776
103. Wilson L, Hall H, McIntosh G et al (1999) Interrater reliability of a low back pain classification system. *Spine* 24:248–254