

Review

Pain in CF: Review of the literature ☆

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**Abstract**

*Background:* This review evaluated pain research in cystic fibrosis (CF).

*Methods:* OVID MEDLINE, CINAHL, AMED, Web of Science, Pubmed, PsychINFO and PsychARTICLES were searched from January 1995–December 2012 to locate papers assessing pain in CF. A proforma was used to record the rationale for the study, characteristics of the sample, pain assessment tools, pain location, frequency and severity, treatment/self-management, coping and the impact on daily activities and quality of life.

*Results:* All studies (n = 13) were retrospective. Chest and abdominal pains were most commonly reported. Pain was negatively associated with pulmonary exacerbations, quality of life and treatment adherence. Approximately 50% of patients do not consult their GP or CF team about pain, with many patients reporting self-management.

*Conclusion:* A high incidence of pain is reported in CF although there is little standardization of CF pain measurement. The way forward is to develop guidelines on how to assess pain and provide adequate treatment for pain in CF.

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*Keywords:* Cystic fibrosis; Pain; Pain assessment; Treatment; Quality of life

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## 1. Introduction

Over the past 10 years studies have shown that pain assessment and pain treatment in Cystic Fibrosis (CF) are important, especially as pain has been associated with survival [1]. Pain reduces the quality of life of chronically ill patients and may negatively impact the ability to participate in disease-related daily care [2–4]. Consequently, the assessment and treatment of pain are imperative [5,6].

This review aims to provide a critical overview of CF pain research that focusses on pain assessment and the impact of pain. Reviewing the CF pain literature in this context is crucial given that little is known. The results should aid the measurement of pain and its clinical management in CF. Important findings will be highlighted to guide future research and clinical decision making.

## 2. Methodology

### 2.1. Search Strategy

A literature search was undertaken independently by two of the authors. The search was limited to full papers in the English language that included the keywords ‘cystic fibrosis’ and ‘pain’ in the title, abstract or keywords. Databases were searched from January 1995 to December 2012 and records identified: OVID MEDLINE (35), CINAHL (39), AMED (12), Web of Science (42), Pubmed (202), PsychINFO (5) and PsychARTICLES (0). Papers were checked for duplicates and relevance to this review resulting in 47 publications that were potentially eligible and were subsequently screened on full text. Eligibility criteria were defined as: papers assessing location, frequency, intensity or duration of pain, well-being and pain, disease severity and pain. Papers were excluded if they were editorials, reviews or meta-analyses, described case studies or were based solely on the clinical/pharmacological treatment of pain. A total of 13 papers met the eligibility criteria and were included in the review. The references of these papers were screened for additional relevant work but no further papers were identified. Table 1 provides a concise overview of this information.

## 3. Results

### 3.1. Rationale and study design

The rationale for undertaking ‘pain research’ in CF has been threefold. The available literature has focussed on 1. evaluation

of the prevalence and characteristics (location, frequency/duration, intensity) of pain; 2. evaluation of the impact of pain on everyday life from both functional and HRQoL aspects; and 3. evaluation of self-management and clinical pain management.

All studies were retrospective, although three studies subsequently assessed patients following either an intervention [15,17] or during an exacerbation [3]. Two studies included the investigation of procedural pain [11,13]. The distinction between acute and chronic pain was made only by two studies [12,16].

The study populations were: children [11,12,17], adults [3,4,9,14,15] or children, adolescents and adults [7,10,13,16]. The papers by Koh et al. [11] and Palermo et al. [12] reported on the same sample of children and adolescents.

### 3.2. The patient communicating about pain

Patients with CF consulted a range of individuals regarding their pain [4,9,11,16]. Approximately 50% of patients (or less) consulted their CF team or their GP [4,9,13]; about a quarter consulted relatives or friends [9] with many reporting ineffective self-medication [13].

### 3.3. Pain assessment tools

Pain assessment typically involves documenting pain location, frequency, intensity and often functional (dis)ability and psychological/social factors by means of pain assessment instruments. A description of the pain assessment tools that authors employed is provided in Table 2. Studies have selected a range of assessment tools to measure pain in CF. Many of these have been developed by the authors themselves without validity or reliability considerations. This approach is labour intensive for researcher/clinicians and participants, but no single assessment tool is available to measure all aspects of pain in CF. Even the Brief Pain Inventory (a validated pain tool) is typically modified to ensure CF specific content [3,14].

Apart from medical chart reporting [7] and nurse reports (two nurses) [8], all assessment tools relied on the patient for self-report. Children and adolescents completed the questionnaires themselves [10–13,16,17], except for one study where parents reported for their children under the age of 8 [13].

Munck et al. [17] was the only study that employed a valid definition of the pain they examined, namely recurrent abdominal pain [18]. They subsequently found that only a minority of children with CF truly presented with recurrent abdominal pain and most children reported abdominal discomfort. Those children with severe pain reported a negative impact on their life.

### 3.4. Pain location

The main locations and prevalence of pain in patients with CF are provided in Table 3. The literature points to a wide variety of pain locations in single patients and to a wide range in prevalence between studies.

### 3.5. Prevalence, frequency and duration of pain

It is difficult to establish the prevalence, frequency and duration of pain in CF given that studies have applied different definitions, time frames and assessment tools (see Tables 1 and 2). Nevertheless, all studies found that pain is frequently reported by many patients. For example, Festini et al. [9] found that 30% of adults suffered pain more than 10 times over a two month period. Hubbard et al. [10] found that 10 out of 18 adult patients reported daily pain. Lee et al. [15] reported that the majority of adult patients had chronic pain for at least 3 months prior to telling their primary physiotherapist.

### 3.6. Intensity of pain

Most studies administered intensity rating scales, but they used different start and end points (e.g. 0–5 or 0–10) [3,4,8,9,12–15]. Hayes et al. [4] found that about one third of patients rated their pain 5 or higher out of 10. Kelemen et al. [3] noted that pain ‘at its worst’ scored 4 (0–10). Kelemen et al. [3] found no difference in average pain intensity or *pain at its worst* between clinically stable patients and acutely ill patients. Daily diary reporting (ranging from no pain to severe pain) showed a highly individualised pattern of pain intensity in the 8 participating patients [17]. Epker et al. [8] found no significant association between patient reports and nurses reports on the perception of pain severity. The two nurses in this study perceived patients to be in significantly more pain than did the patients themselves.

### 3.7. Procedural pain

Koh et al. [11] noted that the majority of patients reported mild procedural pain. A small number of the children and adolescents in this study ( $n = 46$ ) experienced severe pain from blood draws (7%), peripherally inserted central catheter (PICC) placements (9%), gastrostomy placements (8%) and throat cultures (8%). In contrast, Sermet-Gaudelus et al. [13] reported widespread procedural and anticipatory pain. Two-thirds of the sample ( $n = 73$  children and 110 adults) reported pain during blood sampling, with a visual analogue score greater than six (0–10) for one-third. Eighty-six percent of adults reported pain during arterial blood gas taking. Anticipatory pain was reported by 90% of the patients, with most expressing a preference for topical anaesthetics to reduce needle-stick pain. Sixty percent of the adults and 40% of the children with a totally intravenous access device (TIVAD) reported pain during or just after the placement procedure and 85% reported fearing the next TIVAD placement. For bronchoscopy, 80% of children and 90% of the adults reported pain during or just after the procedure.

### 3.8. Disease severity and pain

Disease severity was broadly ‘defined’ in three ways: a. by using FEV<sub>1</sub>% predicted; b. by means of medical descriptions, such as ‘acute illness’, ‘pulmonary exacerbations’, or ‘end-of-life’ and c. by using the Shwachman Rating of Illness Severity (four components: history/general activity level, pulmonary physical findings and cough, nutritional status and chest X-ray findings).

No difference in pain reporting was observed when using FEV<sub>1</sub>% predicted as a parameter of disease severity [13,14]. It may be that FEV<sub>1</sub>% predicted is not a good single indicator to use for disease severity in relation to pain [4]. For children, Koh et al. [11] reported that children with chest pain, who were found to have slightly reduced FEV<sub>1</sub>%, had more perceived functional limitations as a result of their pain, but FEV<sub>1</sub>% was not correlated with the frequency or severity of pain.

Increased intensity of pain was reported in the medical records of patients who had more advanced lung disease (not specifically defined); chest pain and headache increased significantly three months prior to death [7]. Chest pain was also reported specifically associated with acute exacerbations [3] and with an increase in the number of pulmonary exacerbations (deterioration of disease) and death [4,7].

Finally, Epker et al. [8] used the Shwachman Rating of Illness scale but found that self-reported pain was correlated only with history/general activity level.

### 3.9. Well-being and pain

Well-being has been assessed using Cystic Fibrosis specific Health Related Quality of Life scales (HRQoL) [3,4,12,17]. Kelemen et al. [3] found that pain predicted ratings on domains of HRQoL, including physical functioning, social life, symptom and treatment aspects, emotional response and school or work. Kelemen et al. [3] also found that pain catastrophizing was an important correlate to HRQoL. Pain catastrophizing is defined as an exaggerated negative interpretation of pain, which may occur during actual or anticipated painful experiences [19] and provides valuable information about individual response to and appraisal of pain. Certain locations of pain may be related to different domains of HRQoL [4,12]. For example, children with chest pain may be more at risk for depressed mood [12].

Other assessments of well-being included anxiety and depression, for example the Hospital Anxiety and Depression Scale [4] and general emotional well-being assessment tools, for example the Emotional upset scale [11] or the McGill Emotional Status [17]. Table 4 shows how pain is associated with different aspects of well-being.

### 3.10. Pain and interference with CF treatment

Most studies conclude that pain is related to the ability or inability to perform CF treatment [3,4,8–13]. Several studies reported an explicit interaction between pain and a restriction to perform physiotherapy and exercise [3,4,11,13]. For example, Sermet-Gaudelus et al. [13] found that 28% of the children and

Table 1  
Concise overview of reviewed studies.

Author	Rationale	Sample	Pain assessment/time frame	Results (frequency, pain location, treatment/self-management, impact on daily life/HRQoL)
Ravilly et al., 1996 [7]	Examine clinical pain management in relatively sick patients	78 adults 58 deceased, mean age at death = 26 23 alive, mean age 23 Mean FEV <sub>1</sub> = 58%	Chart review February 1986–October 1993	Frequency: All charts showed that patients reported pain, 84% reported serious pain, especially towards death. Locations: chest, headache, back, limb, abdomen. Management: >50% tried non pharmacological approach (acupuncture, TENS, biofeedback); medications: NSAID, tricyclic antidepressants, thoracic epidural analgesia, opioids. Patients attended a pain treatment centre. Impact: not recorded
Epker et al., 1999 [8]	Assessment of pain and pain related impairment in adults with Cystic Fibrosis	75 adults	MPI Time frame not specified	Frequency: 65% reported pain severity of 2 or less, 24% reported no pain. Locations: not recorded. Management: not recorded. Impact: 63% pain-related interference of 2 or less, 17,3% no interference; 38,7% reported an affective distress score of 2 or less and 61,3% reported a score of 3 or less. 60% reported a life control score of 4 or more and 25,3% reported general activities of 4 or greater.
Festini et al., 2004 [9]	Evaluate prevalence of pain, self-management and impact on everyday life	239 adults Mean age = 26 Mean FEV <sub>1</sub> = 56%	Ad hoc questionnaire Past 2 months	Frequency: 225/239 reported pain. Location: headache, stomach, heartburn, backache, bones/muscular pain, abdominal, chest. Management: 24% homeopathic or non-pharmacologic remedies; 91% took medicine, not specified. Impact: 63% unfavourable impact on daily activity.
Hubbard et al., 2005 [10]	Investigate pain experiences, disability and coping strategies	18 adults (12 female) 67 % older than 23 years of age	Web-based questionnaire Retrospective over 1 month	Frequency: 17/18 reported pain. Location: chest, joints. Management: preferred coping style is active and accommodative (problem solving, resting, distraction). Impact: pain affected recreation, occupation, family/home responsibility, sex behaviour, self-care.
Koh et al., 2005 [11]	Assessment of acute and chronic pain and pain management and the relationship of pain with disease severity	46 children and adolescents Mean age 12.9 Mean FEV <sub>1</sub> = 80%	Faces Pain scale Body outline VAS Retrospective over 1 month	Frequency: 46% reported pain at least once a week. Majority reported mild procedural pain. Location: abdominal/pelvic, chest, head/neck. Management: rest, relaxation, heat or cold, family/friends, distracting; medication: acetaminophen, NSAID. Impact: children with chest pain were at risk for experiencing functional limitations and lower FEV <sub>1</sub> %.
Palermo et al., 2006 [12]	Assessment of pain and impact on HRQoL	46 children and adolescents Mean age 12.9 Mean FEV <sub>1</sub> = 80%	Faces Pain scale Body outline VAS Retrospective over 1 month	Frequency: 46% experienced pain at least once a week. Location: abdominal/pelvic, chest, head/neck. Management: not recorded. Impact: pain was associated with decrements in HRQoL across multiple domains.
Sermet-Gaudelus et al., 2009 [13]	Assessment of pain prevalence, symptoms and treatment. Evaluation of the relationship between pain, disease severity and HRQoL	73 children, Mean age 10.2 Mean FEV <sub>1</sub> = 70% 110 adults Mean age 28.5 Mean FEV <sub>1</sub> = 50%	Ad hoc questionnaire Body outline drawings Retrospective over 1 month	Frequency: 59 % of children and 89% of adults reported at least one episode of pain. 85% and 78% reported procedural pain and anticipatory pain, more frequent in severe disease. Location: head, chest, abdominal (children > adults), backache (adult > children), muscular ache (child > adult). Management: 40% of children and 50% of adults reported use of analgesics: acetaminophen, NSAID, aspirin, antispasmodic treatments, opioids. Impact: 50% of children and 70% of adults reported intense, long-lasting and recurrent pain episodes that impacted their QoL.

Table 1 (continued)

Author	Rationale	Sample	Pain assessment/time frame	Results (frequency, pain location, treatment/self-management, impact on daily life/HRQoL)
Flume et al., 2009 [14]	Association between pain and sleep quality	50 adults Mean age 31 Mean FEV <sub>1</sub> = 58%	Brief Pain Inventory Pittsburgh Sleep Quality Index Retrospective over 1 month	Frequency: 64% reported pain within last month. Location: abdomen, back, chest, extremities, head and neck. Management: not recorded. Impact: Pain is strongly correlated with impaired sleep.
Lee et al., 2009 [15]	To assess a single musculoskeletal treatment session to alleviate pain and ease breathing	105 adults Mean age 30.5 Mean FEV <sub>1</sub> = 48.1%	Body outline drawings Past 3 months	Frequency: 90% reported chronic pain. Location: musculoskeletal pain. Management: Improvement in ease of breathing was achieved using a combined approach of manual mobilization technique and massage therapy. Impact: pain impacts airway clearance and exercises.
Stenekes et al., 2009 [16]	To assess self-management of pain, dyspnoea and cough	64 children and 59 adults, Mean age 20 years	Ad hoc questionnaire Retrospective over 1 month	Frequency: 84% reported pain. Location: headache and abdominal pain. Management: non-pharmacological (resting, doing nothing, heat, cold); medication: acetaminophen, NSAID, aspirin, antispasmodic treatments, opioids. Impact: pain inhibited daily activity especially with increasing severity of pain.
Hayes, 2011 [4]	To assess the factors associated with pain and its impact on clinical outcome	83 patients Median age 29 Median FEV <sub>1</sub> = 64%	Brief Pain Inventory Online Survey Retrospective over 1 month	Frequency: 82% reported moderate to severe pain. Location: head, sinuses, back, chest, abdomen, joints. Management: not recorded Impact: pain is associated low mood, poor HRQoL, pulmonary exacerbations and death.
Kelemen et al., 2011 [3]	Prevalence, severity and location of pain. Psychosocial consequences and impact on HRQoL	73 adults Mean age 30 FEV <sub>1</sub> = 60% Prospective study of 33 patients with acute exacerbation	Body outline drawing Brief Pain Inventory Previous week	Frequency: 89% reported pain. Location: head, neck, joints, chest. Management: not recorded Impact: pain interfered with airway clearance for those with acute exacerbations and exercise interventions. Pain was related to poorer physical functioning, emotional status and greater interference with CF treatment, including exercise. Pain catastrophizing correlated with increasing pain.
Munck et al., 2011 [17]	Prevalence of recurrent abdominal pain its management and impact on HRQoL	8 children Mean age 14 Mean FEV <sub>1</sub> = 85%	Faces Pain scale Eland pain location Ad hoc questionnaire 28 daily pain diary	Frequency: 8/130 patients fulfilled criteria for recurrent abdominal pain. Location: abdominal pain. Management: behavioural interventions and increasing pancreatic enzymes. Impact: pain according to criteria has strong impact on daily life.

FEV<sub>1</sub> = Forced Expiratory Volume 1st second; MPI = Multidimensional Pain Inventory; TENS = Transcutaneous Electrical Nerve Stimulation; NSAID = nonsteroidal anti-inflammatory medications; VAS = Visual Analogue Scale; HRQoL = Health Related Quality of life.

10% of the adults reported pain during physiotherapy. No preventative strategies were used to avoid the symptoms.

Hayes et al. [4] suggest that pain may lead to decreased mechanical airway clearance, either because patients are in too much pain to participate in airway clearance activities or because the airway clearance treatment exacerbates their pain, which can worsen infections and promote new ones.

### 3.11. Pain management

Studies specifically examining the pharmacological treatment of pain were excluded from this review. However, eight studies did report on patients' management of their pain, which will be described in two parts; namely a. the use of medication to relieve the pain and b. other ways to relieve the pain. It is acknowledged that this section may result in bias when

discussing pain management, but it will provide a foundation for future work in this area.

#### 3.11.1. Medication use

Based on medical records, Ravilly et al. [7] noted that nonsteroidal anti-inflammatory (NSAIDs) medications were used as initial therapy for pain in the majority of patients. No complications were recorded. With increasing illness, thoracic epidural analgesia and opioids were prescribed. Constipation was described as a complication of opioid use. Opioid dosing over time did not suggest progressive dose escalation nor tolerance in 9 out of 10 patients. Only one patient exhibited signs of drug-seeking behaviour.

For children, Koh et al. [11] reported that those who were given medication (especially those with head/neck pain) took acetaminophen or NSAIDs, or a combination. None of the children in this study took opioids for pain management. Hayes



Table 2  
Pain assessment tools.

Assessment tool	Studies employing the tool	Description of tool
Medical Chart Review	[7]	Assessed pain location and frequency (note: authors defined headache and chest pain using standardized criteria).
Multidimensional Pain Inventory	[8]	Three sections: impact of pain on patients' lives, the response of significant others to the patients when they are in pain and the extent to which patients participate in common daily activities.
Faces Pain Scale	[11,12]	5 scales were used: pain severity, interference, life control, affective distress and general activity level. Pain severity: 7 faces (no pain–worst pain ever). Pain frequency: 6 point scale (less than 1 month to daily). Pain duration: 4 point scale (less than 1 h to all day). Pain bother: 5 point (not at all to very much).
Faces Pain Scale-revised	[17]	Assessed pain intensity for the episode that had caused the greatest pain.
Body Outline Drawings	[11,12]	Scored (pain/no pain) for 9 anatomical areas according to standardized body regions.
	[13]	Scored (pain/no pain) for several anatomical areas according to standardized body regions.
	[15]	Scored (pain/no pain) for several locations on the anterior and posterior view of a body outline.
	[3]	Scored (pain/no pain) for 45 anatomical areas according to standardized body regions.
Eland pain location	[17]	Children identify pain location on body drawing and use colour to indicate the intensity of the pain.
Daily Diaries	[17]	28 day pain diary that assessed frequency, intensity, duration and management of pain.
Ad hoc questionnaires/ Interviews	[9]	Structured questionnaire assessing pain location (9 regions), intensity (with 1 = mild to 10 = severe) and frequency of pain, pain management and the negative consequences of pain on everyday life.
	[11,12]	Visual Analogue Scale, assessed activity limitation (0–10 point scale).
	[13]	Structured questionnaire assessing pain frequency (less than once a month to daily), pain intensity (VAS 0–10, no pain to worst pain imaginable), duration (VAS 0–10, less than one hour to all day) and chronicity (recurrent or continuous for more than 6 months). Impact of pain on daily life and CF treatment management.
	[16]	Structured questionnaire assessing duration of pain (headache, abdominal), dyspnoea and cough and self-management.
	[17]	Questions about how abdominal pain interfered with everyday activity (130 children). This information was used to select patients for prospective pain evaluation (n = 8).
Pain Disability Index	[10]	Web-based questionnaire assessing pain intensity, duration and frequency.
Brief Pain Inventory (BPI)	[10]	7 items assessing how pain disrupts normal activities on a 0–10 point scale (no disruption to totally disrupted).
	[4]	Frequency of pain in the past week/month. Pain severity on a 0–10 point scale (no pain to bad as you can imagine). Pain interference with 7 aspects of daily life (on a 0–10 point scale).
	[14]	Modified the BPI by including an item relating to the impact of pain on CF treatment management.
	[3]	Modified the BPI by adding 4 items relating to the impact of pain on cough, breathing, exercise and airway clearance.

et al. [4] found that many patients used over the counter medications (acetaminophen, 43%; ibuprofen, 58%).

Sermet-Gaudelus et al. [13] provide a detailed account of the drugs used by the patients in their sample. They found that 40% of the children and 50% of the adults with pain reported using analgesics. Acetaminophen was used most frequently (59%) followed by NSAIDs (10%) and aspirin (5%). Abdominal pain was treated mainly with antispasmodic treatment and increased pancreatic enzymes. One patient in this study used opioids. Frequency of treatment did not differ between the children and the adults. Sixty-five percent of the children and 60% of the adults reported significant relief after treatment whereas 25% of the children and 10% of the adults reported either very limited or no effectiveness.

Table 3  
Range of % of patients reporting pain according to locations.

Headache/sinus	25%–64%
Chest pain	16%–72%
Back pain	15%–70%
Gastrointestinal pain	10%–51%
Musculoskeletal pain	12%–61%

Apart from Ravilly et al. [7] and Sermet-Gaudelus [13], the reports did not describe duration of analgesic medication use nor risk of drug dependence.

### 3.11.2. Other ways to relieve the pain

Some patients took no actions against their pain, possibly because of high tolerance to pain or not wanting to increase their treatment burden [9,11,13]. Nevertheless, many patients did take some action to alleviate the pain, other than medication [4,9,11,13,16,17]. These actions included homeopathic products or non-pharmacological remedies (massages, acupuncture, herbal remedies, physical activities, rest, heat or cold, distracting activities, yoga, meditation, self-hypnosis or osteopathy). Hubbard et al. [10] studied the way patients coped with the pain and found that patients preferred to use active and accommodative techniques to cope with pain, including problem solving, resting, and distraction.

Finally, Munck et al. [17] described two patients regularly attending appointments with a pain management team which successfully relieved pain as well as emotional upheaval, anxiety and stress. Ravilly et al. [7] also reported successful follow up by a pain treatment centre. Munck et al. [17] also found that in two patients stopping the high intake of fizzy beverages and optimizing pancreatic enzymes alleviated their abdominal pain.

Table 4  
Pain and well-being.

Worse pain is associated with:	Reference
More symptoms of anxiety and depression	[4]
Poorer physical functioning	[3,8–11,13,16]
Worse emotional status	[3,4,8,11–14,17]
Impairment of sleep	[12,13]
Impairment of exercise and work-related tasks	[3,4,8–12]
Restriction on daily activities	[4,8,13,16]

### 3.12. Pain intervention studies

Two studies evaluated a specific treatment for pain [15,17]. Lee et al. [15] studied the effect of manual mobilization techniques and massage therapy on pain and improvement of ease of breathing, both with positive results. Munck et al. [17] identified children using a defined pain assessment score for abdominal pain, the Apley definition [18] and set up an individualized treatment plan for each child. The treatment plans led to an improvement in pain reports. Both studies advocate an individual approach to pain and pain management.

### 3.13. Limitation of studies

A main limitation of current CF pain research is that there is little standardization in the pain measures used or the time frame for assessing pain. The distinction between acute and chronic pain was rarely used. The large variation in the frequency of pain may be attributed to the differing definitions of pain applied and time frames selected [3]. A further limitation is the lack of control groups [15] to differentiate between CF related pain and pain patients experience similar to a non CF population. Also, the association between cough and pain intensity has not been well addressed and little is known about the association between health care use and pain reporting. The latter is from a cost–benefit point of view important. The studies evaluated patient reported medication use and other ways to relieve pain, but limited data is available on duration of analgesic medication use or risk of drug dependence. Finally, Munck et al. [17] and Lee et al. [15] demonstrated that short-term interventions were beneficial but long-term studies are needed.

### 3.14. The way forward

This review highlights the importance of pain and pain assessment in CF. A high incidence of pain is reported in CF with evidence that pain is negatively associated with performing physiotherapy and exercise [4,11,13], pulmonary exacerbations [3,4,7], quality of life [3,4,12] and survival [1]. It has been suggested that pain may be an important marker of inflammation and ‘disease activity’ although evidence is lacking to corroborate this [4,7]. The relationship between pain and FEV<sub>1</sub>% predicted remains unclear [11]. This stimulates the discussion about whether there is increased (chest) pain due to more advanced disease, or whether reduced lung function (assessed by FEV<sub>1</sub>% predicted) results from a higher level of chest pain. In relation to this, future

research should investigate the association between cough and pain intensity and the differentiation between acute and chronic pain in CF. A prospective study on pain in CF is urgently required.

The way forward would seem to be the integration of pain assessment in the CF clinic [16]. Given that half of people with CF do not communicate with their physician about their pain it is crucial to make pain assessment and management part of the care plan. This would also clarify the association between patients’ health care use and prevalence of pain.

We face the challenge of developing a standardised, valid and reliable pain assessment for CF together with appropriate treatment plans/guidelines on how to deal with pain in CF. Efficient pain management will improve patients HRQoL and help patients to perform essential interventions and treatments that prevent early deterioration.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.jcf.2013.04.001>.

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