The Attitudes and Beliefs of Physiotherapists Treating Back Pain

Development and validation of the Norwegian version of the Pain Attitudes and Beliefs Scale (PABS)

Nicolaas Dingeman Eland

Thesis for the degree of Philosophiae Doctor (PhD)
University of Bergen, Norway
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Abstract

BACKGROUND: Low back pain (LBP) is a common musculoskeletal condition. constituting a significant health care problem in developed societies. The available literature suggests that negative attitudes and maladaptive beliefs of clinicians can serve as obstacles for the delivery of optimal care to patients with LBP. Furthermore, the back-pain beliefs of physiotherapists are found to influence the back-pain beliefs and the illness perceptions of their patients, with a profound effect on patient outcome. Evaluation of these attitudes and beliefs is necessary for the implementation of a comprehensive and more systematic patient management, in line with evidence-based clinical guidelines. The Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) is a questionnaire, originally developed in Dutch, that aims to measure physiotherapists' attitudes and beliefs by differentiating between two dominant treatment orientations in musculoskeletal care on two subscales, one representing a biomedical, the other representing a biopsychosocial treatment orientation.

OBJECTIVE: The purpose of the PhD thesis was to develop a Norwegian version of the PABS-PT, comprising a stepwise validation process in four parts: 1. Translation from the Dutch version into Norwegian and examination of structural validity and internal consistency. 2. Examination of internal construct validity based on modern test theory with Rasch modelling. 3. Examination of discriminative validity of the scale. 4. Examination of content validity. The four parts of this validation effort are covered in four papers.

In PAPER I, the PABS was translated and cross-culturally adapted, followed by an examination of the underlying dimensionality and internal consistency. Data for exploratory factor analysis were collected from 647 physiotherapists responding to a cross-sectional web-based survey. Analysis revealed a two-factor structure and 36 items were reduced to 19 items, 13 items loading on the biomedical factor and 6 items loading on the biopsychosocial factor. Internal consistency was found to be sufficient for the biomedical but too low for the biopsychosocial subscale. The two factors accounted for low explained variance, which may be indicative for problematic

construct validity. Therefore, in PAPER II, construct validity of the PABS-PT was examined more closely by applying Rasch modelling to the data collected in a sample of 667 physiotherapists. Rasch model analysis resulted in an improved scale with two strictly unidimensional subscales, each holding seven items, and with invariant item ordering and free from any form of misfit. The improved PABS allows for ordinal raw scores to be transformed into interval-level scores, rendering a greater accuracy to compare scores between groups of persons and justifying the use of parametric calculations, like means and differences. However, low separation indexes indicated limitations regarding the PABS' ability to differentiate between clinicians with a traditional biomedical treatment orientation and clinicians with a biopsychosocial orientation.

Therefore, in PAPER III we examined the discriminative validity of the PABS in more detail. A construct validation by hypothesis testing was performed using a sample of 662 physiotherapists. Twenty-four a priori hypotheses were formulated about expected differences between known subgroups of physiotherapists, based on evidence from research. Discriminative validity was considered adequate when at least 75% of the hypotheses were confirmed. Analysis showed that discriminative ability of each separate subscale was insufficient. Furthermore, subgroup analysis of respondents with high biomedical and low biopsychosocial scores (and vice versa) identified the presence of extreme treatment orientations. Differences in treatment orientation among physiotherapists were very small, indicating that Norwegian physiotherapists may basically be similar in their treatment orientation. Alternatively, they gave socially desirable responses, or the PABS is just not able to detect any differences between them.

To explore the possible presence of social desirability or homogeneity in responses, the next step was to qualitatively examine the content validity of the PABS by assessing the relevance, comprehensibility and especially the comprehensiveness of the items. Therefore, in PAPER IV, we performed cognitive interviews using the Three-Step Test-Interview (TSTI) method and asked eleven physiotherapists how they understood and interpreted the items of the PABS. Our results indicated that all items

were relevant and important for physiotherapists. Five of fourteen items had ambiguous formulations, but these can be handled with some slight modifications. The biomedical subscale appeared to be a comprehensive representation of biomedical treatment orientation. The biopsychosocial subscale, however, lacks comprehensiveness, as it is not able to capture important aspects of contemporary biopsychosocial best practice care. Measurement of biopsychosocial treatment orientation may therefore be incomplete.

CONCLUSION: We developed a 14-items Norwegian version of the PABS and subjected it to a scrutinous validation process. We improved the scale performance by rendering the subscales strictly unidimensional, free from misfit and with an invariant, hierarchical item ordering. We were able to improve the item performance by suggesting some slight alterations for better comprehensibility. We identified two major shortcomings: the scale in its original form has poor discriminative ability and the biopsychosocial subscale has limited comprehensiveness, as it does not capture important aspect of contemporary biopsychosocial best practice care.

RELEVANCE AND RECOMMANDATIONS: To provide broader insights into clinicians' attitudes and beliefs, we recommend complementing the PABS with other questionnaires measuring related biopsychosocial constructs, such as practitioners' confidence, patient-centeredness and knowledge of modern pain neurophysiology. Item performance may be improved by including the suggested item modifications. In addition, the applicability of the scale may be extended by combining high scores on one subscale and low score on the other, allowing the identification of physiotherapists with extreme (biomedical or biopsychosocial) treatment orientations.

List of Publications

Paper I

Eland N.D., Kvåle A., Ostelo R.W.J.G., & Strand L.I.

The Pain Attitudes and Beliefs Scale for Physiotherapists: Dimensionality and Internal Consistency of the Norwegian Version.

Physiotherapy Research International, 2017, 22 (4) 11-19.

Paper II

Eland N.D., Kvåle A., Ostelo R.W.J.G., & Strand L.I.

Rasch analysis resulted in an improved Norwegian version of the Pain Attitudes and Beliefs Scale (PABS).

Scandinavian Journal of Pain, 2016, 13 (October), 98-108.

Paper III

Eland N.D., Kvåle A., Ostelo R.W.J.G., de Vet H.W. & Strand L.I.

Discriminative Validity of the Pain Attitudes and Beliefs Scale for Physical Therapists.

Physical Therapy, 2019, 99 (3), 339-353.

Paper IV

Eland N.D., Strand L.I., Ostelo R.W.J.G., Kvåle A., & Magnussen L.H.

How do physiotherapists understand and interpret the “Pain Attitudes and Beliefs Scale”? A cognitive interview study.

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List of abbreviations

ABS-ml	Attitudes to Back pain Scale in Musculoskeletal Practitioners
BBQ	Back Beliefs Questionnaire
BMS-10	Biomedical Subscale with 10 items
BPSS-9	Biopsychosocial Subscale with 9 item
BMIS-20	20-items Biomedical Item Set
BPSIS-16	16-items Biopsychosocial Item Set
CAT	Computer Adaptive Testing
CBT	Cognitive Behavioral Therapy
CG	Clinical Guidelines
CFA	Confirmatory Factor Analysis
CFT	Cognitive functional therapy
CIRF	Cognitive Interviewing Reporting Framework
COSMIN	Consensus-based Standards for the Selection of Health Measurement Instruments
CTT	Classical Test Theory
DIF	Differential Item Functioning
EFA	Exploratory Factor Analysis
FABQ	Fear Avoidance Beliefs Questionnaire
HC-PAIRS	Health Care providers' Pain And Impairment Relationship Scale
HELFO	National Health Finance Administration
ICC	Intraclass Correlation Coefficient
i.e.	Id est
ICF	International Classification of Functioning, Disability and Health
HCP	Health Care Provider
KMO	Kaiser-Mayer-Olkin test
LOA	Limits of Agreement
LBP	Low Back Pain

NSLBP	Non-Specific Low Back Pain
NPA	Norwegian Physiotherapy Association
PT	Physical Therapist, Physiotherapist
PSI	Person Separation Index
PABS	Pain Attitudes and Beliefs Scale
PABS-PT	Pain Attitudes and Beliefs Scale for Physiotherapists
PAF	Principal Axis Factor Analysis
PIP	Psychologically Informed Physiotherapy
PCA	Principal Component Analysis
PNE	Pain Neuroscience Education
PHODA	Photograghic series Of Daily Activities
PROM	Patient Reported Outcome Measure
RMT	Rasch Measurement Theory
SDC	Smallest Detectable Change
SD	Standard Deviation
SEM	Standard Error of Measurement
TSK	Tampa Scale of Kinesiophobia
TSK-HC	Tampa scale of Kinesiophobia for Health Care providers
TSTI	Three-Step Test-Interview
YLD	Years Lived with Disability

Contents

1. Introduction

When there is no clear pathophysiological explanation for non-specific low back pain, and there is a lack of detailed guidance on diagnostic issues and treatment, clinicians' interventions are likely to be informed by their personal attitudes and beliefs (Foster et al., 2003). This thesis addresses the measurement of attitudes and their associated beliefs. The word attitude is derived from Latin and means "fitness" and "aptness", representing a mental state of preparation for action. An attitude is simply defined as "an evaluation of an object of thought" (Vogel and Wanke, 2016, page 2). Attitude objects comprise anything a person may hold in mind; a person, a group or any object in our social world. Having attitudes involves making decisions concerning liking versus disliking or favoring versus disfavoring. Attitudes are important because they have an impact on our perception of the world and our behavior.

Attitudes are assumed to be based on behavioral beliefs and it is doubtful whether attitudes can be influenced directly. Changes in attitude are assumed to follow from changes in beliefs about the consequences of the target behavior (Sutton, 2003). This means, that when clinicians believe that adopting a biopsychosocial approach mainly produces positive outcomes, their attitudes toward this behavior will be favorable (Godin et al., 2008).

Ajzen and colleagues (Ajzen et al., 2011) stated that having accurate information about an issue (e.g. clinical guidelines on low back pain) can be quite irrelevant for decision-making. They argue that instead of providing people with accurate information (e.g. via instructions or guidelines), it may be better to identify the subjective beliefs people hold towards the issue and to explore how these beliefs affect their intentions and behaviors. Then, it may be possible to challenge the beliefs that impede the adoption of the desired behavior or to facilitate the development of new beliefs that promote the desired behavior (de Leeuw et al., 2015). This thesis is about identifying the subjective beliefs of physiotherapists treating patients with low back pain.

2. Background

2.1 Low back pain

Low back pain (LBP) is a very common musculoskeletal disorder, constituting a major socio-economic health problem and a significant management challenge to health care providers (Hartvigsen et al., 2018, Breivik et al., 2013). Globally in 2016, low back pain was the leading causes of Years Lived with Disability (YLDs) (Vos et al., 2017). In Norway, approximately 60% of the population reported to have suffered from LBP at least sometime during their lifetime and approximately 40% to have experienced LBP sometime during the preceding year (Ihlebæk et al., 2006). Chronic LBP conditions are common, as shown in a Dutch study. During a study period of 10 years, 20% of the adult population reported longstanding LBP (van Oostroml et al., 2011). Six percent of the concerned population could be characterized as persistent back pain sufferers, whereas only 30% reported to be completely free of LBP during the entire period.

Among musculoskeletal disorders, LBP is the most frequent medical reason for work absenteeism and disability pensions in Norway, representing respectively 11% and 9% of all cases in 2008 (Brage et al., 2010). In 2015, there were 35.000 persons with disability pension related to back pain with 3000 new cases of disability retirement that year (source: www.nav.no-statistik-uføretrygd). However, since the year 2000, there has been a marked decrease in the number of cases of back pain-related sickness absence and disability retirement in Norway, as in several other European countries (Brage et al., 2010).

Low back pain is one of the most common reasons for use of primary health care in Norway (Kinge et al., 2015, Hunskår, 2003), accounting for about 10% of medical consultations, 27% of all physical therapy consultations and 82% of chiropractor consultations (Werner et al., 2005). In seeking care, 25% of patients who had

experienced LBP, had visited a general practitioner, 17% had visited a physiotherapist and 18% had visited a chiropractor (Werner and Indahl, 2005).

Although LBP is commonly classified as acute (less than 12 weeks) or longstanding/chronic (more than 12 weeks), its course is often characterized by relapses and recurrences over time. One-year recurrence rate has been estimated to vary between 24 and 88% (Lemeunier et al., 2012) (Hoy et al., 2010). Another study reported that 60-80% of first-time LBP patients still experienced pain symptoms and related disability one year after the first consultation with their general practitioner (Croft et al., 1998).

2.2 Biomedical perspective on low back pain

A biomechanical and biomedical model of understanding the structure and the function of the spine has traditionally dominated education and clinical practice in physiotherapy. In a biomedical or impairment-based perspective on LBP, the patient's signs and symptoms are central in clinical reasoning. They are considered to be the result of structural and biomechanical deficits, causing functional aberrations like hypo- and hypermobility or neuromuscular dysfunctions. Assessment is therefore aimed at identifying specific structures, lesions or movement restrictions that can explain the pain and disability (Lederman, 2011, Maitland, 1986, Ombregt, 2013). As pain is considered a signal of tissue damage, injury and nociception, treatment will probably be adapted to the patient's pain level. Therefore, a biomedical approach is often described as being "pain contingent "(Turk and Flor, 1984).

The biomedical model of illness has been criticized for being a reductionist approach for dealing with a complex problem in a simplistic manner (O'Sullivan, 2012). From a theoretical point of view, the biomedical model of illness is rooted in a predominantly linear look at the world, which is most appropriate when linear problems are to be handled, with clear cause-effect relationships and "one-size-fits-all" solutions (Brown, 2009). However, when complex problems like persistent pain

are concerned, linear pathoanatomical thinking and focusing on finding the single best solution is inadequate. Applying such single-dimensional solutions to complex pain problems may actually result in an exacerbation of the pain problem (Brown, 2009) and result in iatrogenic disability (Waddell, 2004, Lin et al., 2013).

2.3 Paradigm shift in LBP management

The traditional biomedical view of LBP has been greatly challenged over the past two decades, as it became recognized that pain has both sensory, affective and cognitive dimensions, and that the affective and cognitive dimensions are an integral part of pain rather than a secondary effect (Turk and Flor, 1984, Waddell, 2004). Furthermore, randomized controlled trials investigating various biomedical interventions failed to show clinically meaningful long-term effects for patients with chronic non-specific low back pain (Hayden et al., 2005, Foster et al., 2003, van Middelkoop et al., 2011). It has also become increasingly clear that, in most cases of LBP, it is very difficult to point out a precise patho-anatomical substrate that can explain the patients' complaints. Common patho-anatomical findings such as degenerative disc disease, annular tears, fissures, facet joint arthrosis and disc bulges have not been found predictive of LBP and associated disability (Jarvik et al., 2005). Consequently, as specific causes of back pain are relatively infrequent, the majority of LBP patients (at least 85%) are diagnosed as having non-specific LBP (Waddell, 2004).

It is now understood that non-specific LBP, especially when long-standing, is a complex disorder that should be considered within a multidimensional bio-psycho-social framework. Strong evidence suggests that disability levels are more closely associated with cognitive and behavioral aspects of pain than with patho-anatomical aberrations (Buchbinder et al., 2010, Main and George, 2011, Gatchel et al., 2007). There is also strong evidence that patients' depression, negative back pain beliefs, fear-avoidance beliefs, psychological distress and passive coping strategies, rather

than pain, are independently associated with persistent disabilities (Ramond et al., 2011), and are strong predictors of disability, health care visits and sick-leave (Boersma and Linton, 2006) (Mitchell et al., 2010) .

2.4 The biopsychosocial perspective

The biopsychosocial model of pain posits that the pain experience and its impact on the individual is the consequence of many interacting physical, behavioral, lifestyle, neurophysiological, psychological/cognitive and social factors. This makes it a complex disorder that seldom follows a linear pathway and therefore requires a range of management strategies (Gatchel et al., 2007, Brown, 2009, O'Sullivan et al., 2016). Assessment is primarily aimed at identifying maladaptive cognitive behaviors (negative beliefs, fear-avoidance, catastrophizing, hypervigilance), pain and movement behaviors (O'Sullivan, 2012). Treatment is based on cognitive behavioral principles and focus on increasing activity despite of pain (Main and George, 2011). Treatment is progressed according to a predetermined timeline rather than the patient's symptoms and is therefore usually referred to as "time contingent" (Lindstrom et al., 1992, Main et al., 2008).

A major feature of the biopsychosocial model is its recognition of the important role of psychological factors in the development of chronicity in low back pain disorders (Waddell, 2004, page 231). Nonspecific factors, such as therapeutic alliance, patient beliefs and expectations, therapist confidence, pain catastrophizing, and self-efficacy, have been shown to be more predictive of clinical outcomes than targeted changes at impairment level, like muscle timing or posture (Hall et al., 2010, Smeets et al., 2006, O'Sullivan et al., 2016). Furthermore, positive outcomes in randomized controlled trials have been found to be best predicted by changes in psychological distress, fear avoidance beliefs, self-efficacy in controlling pain and coping strategies (Mannion et al., 2001).

In back pain research, there has been special focus on the influence of fear avoidance beliefs (Crombez et al., 1999, Vlaeyen and Linton, 2000). The fear avoidance model is a cognitive-behavioral account that explains why a minority of LBP patients may develop a chronic pain problem by engaging in protective behaviors, such as guarding and taking rest, because of fear for pain (Leeuw et al., 2007, Crombez et al., 2012, Vlaeyen and Linton, 2012). These patients may avoid resuming certain physical activities if they believe that it will worsen their pain condition. A vicious circle may develop where pain triggers fear and catastrophizing leads to avoidance that in turn heightens the perception of pain, leading to still more avoidance and deconditioning (Linton et al., 2002). It has been suggested that the fear of pain may result in more disability than the pain itself (Crombez et al., 1999, Waddell, 2004, page 227).

2.5 Clinical practice guidelines for LBP

Clinical guidelines recommend health care providers to incorporate the biopsychosocial model of care into their clinical practice (Koes et al., 2001, Bekkering et al., 2003, Lærum et al., 2007, NICE, 2016, Oliveira et al., 2018). Generally, guidelines recommend reassuring patients and teach them self-management, encourage them to stay physically active despite of pain, continue with normal daily activities and return to work as soon as possible. Furthermore, patients' maladaptive cognitive behaviors (negative beliefs, fear-avoidance, catastrophizing, hypervigilance), pain behaviors and movement behaviors should be addressed and, if necessary, be modified (Koes et al., 2010). Guidelines recommend a flags approach for assessment and management of CLBP, which is a conceptual framework that integrates cognitive and behavioral approaches (Kendall, 1999). After exclusion of serious conditions, (red flags), health care professionals should assess psychosocial prognostic factors for prolonged disability (yellow flags), workplace beliefs and return to work (blue flags) and contextual factors surrounding the individual (black flags).

However, in spite of the evidence that guideline adherence improves outcomes and decreases health care utilization (Rutten et al., 2010), physiotherapy management often appeared to be inconsistent with guideline recommendations (Swinkels et al., 2005). Data suggested that a significant number of therapists continued to have a biomedical approach in their clinical reasoning (Pincus et al., 2006a, Vlaeyen and Linton, 2006, Pincus et al., 2007, Oostendorp et al., 2015, Daykin and Richardson, 2004, Foster, 2011). Physiotherapists with a biomedical orientation and high levels of fear avoidance beliefs seemed to enhance their patients' irrational and dysfunctional concerns about their back pain (Foster et al., 2003, Domenech et al., 2011, Darlow et al., 2012). They typically advised them to restrict activity, be vigilant about their backs and reinforced their beliefs in a structural cause of back pain (Bishop et al., 2008, Synnott et al., 2015, Main et al., 2010).

Barriers to clinicians' guideline adherence are not fully known, but may include reliance on own clinical experience, their perception of clinical guidelines as dictating clinical judgment, and a limited knowledge of guideline content (Slade et al., 2016). Other proposed barriers to changing clinical behavior are clinicians' own fear-avoidance beliefs (Coudeyre et al., 2006) and a lack of communication skills to apply guidelines in the treatment of the individual patient (Jeffrey and Foster, 2012). Patient-related factors and the patient-therapist relationship have been found to be of importance when clinicians experience that some patients have beliefs, coping strategies and expectations that do not match with guideline recommendations (Schers et al., 2001, Espeland and Baerheim, 2003, Gardner et al., 2017). However, an important reason for not changing clinical behavior may be a belief of the healthcare professional that they are poorly trained and under-prepared to adopt a biopsychosocial approach (Synnott et al., 2015).

2.6 Patients' attitudes and beliefs toward LBP

Patients' unhelpful beliefs (e.g. negative affect, low self-efficacy, catastrophizing, maladaptive coping strategies and fear avoidance) can predict long-term disability (Linton, 2000, Denison et al., 2004, Linton, 2005) and influence the outcome of LBP conditions, irrespective of the severity of symptoms or any underlying physical pathology (Waddell, 2004).

Patients' back pain beliefs are influenced by various factors, including previous pain experiences (Leeuw et al., 2007, Vlaeyen et al., 2016), cultural group affiliation (Sanders et al., 1992, Orhan et al., 2018), level of education (Dionne et al., 2001), socio-economic status (Hagen and Thune, 1998) and the prevailing cultural (mis)conceptions about LBP and disability in society (Goubert et al., 2004). The projected attitudes and beliefs of society, family members and work colleagues, but also the beliefs of the patient's own health care provider, may influence the beliefs and thereby the coping strategies and illness behavior of the patient (Rainville et al., 1995, Waddell, 2004). The recommendations and explanations offered to patients by their health care provider can have a profound effect on their back pain beliefs, and this effect may be negative (Pincus et al., 2012, Setchell et al., 2017). As Linton and colleagues (Linton et al., 2002) put it: Not only patients, but also health care providers may have fear-avoidance beliefs.

2.7 Health care providers' attitudes and beliefs toward LBP

Therapists have been found to hold a range of attitudes and beliefs about LBP and there is evidence that these attitudes and beliefs are associated with certain treatment behaviors (Rainville et al., 1995, Linton et al., 2002, Bishop et al., 2008, Ostelo and Vlaeyen, 2008, Evans et al., 2010, Domenech et al., 2011, Simmonds et al., 2012). Treatment behaviors such as the choice of treatment, the explanations given to patients regarding the cause of their back pain, recommendations on sick-leave, work and activity, or referral to supplementary (radiological) investigations, appear to be

related to the pain beliefs of clinicians. Clinicians may emphasize differing treatment outcomes, like pain relief, functional restoration or return to work and society, and these choices may be an expression of their personal attitudes and beliefs (Rainville et al., 2000).

Furthermore, there is strong evidence that the beliefs and attitudes of patients with LBP are associated with the beliefs and attitudes of the health care provider whom they have consulted (Darlow et al., 2012). The different back pain beliefs among chiropractors, general practitioners and physiotherapist were found to correspond to the beliefs of their patient regarding the self-limiting nature of LBP (Werner et al., 2005). Health care providers with elevated fear avoidance beliefs tended to advice their patients to limit work and activities (Linton et al., 2002, Coudeyre et al., 2006). Health care providers' negative back beliefs can possibly reinforce patients' unhelpful illness perceptions, increase spinal vigilance and in that way contribute to chronic disability (Pincus et al., 2006a). There are also indications that health care providers' attitudes and beliefs are associated with patients' outcome: patients of doctors with a treatment style emphasizing bed rest and pain contingent analgesics had significantly more disability at follow-up than patients of doctors promoting self-management (Von Korff et al., 1994).

The variety of attitudes and beliefs among health care providers have been categorized into two different treatment orientations, representing a biomedical or a biopsychosocial perspective on LBP management (Ostelo et al., 2003). However, although these orientations may be conceived as opposites or widely different, they are not necessarily contradictory, as it seems possible for health care providers to hold paradoxical beliefs based on both perspectives (Brown, 2009). This means that both perspectives may be true under certain circumstances, at certain times and for certain people.

The available studies suggest that the negative back beliefs based on biomedical treatment orientations of health care providers may serve as obstacles for the delivery of optimal care of patients with LBP (Pincus et al., 2012). A review of quantitative

studies showed that biomedical treatment orientation was associated with advice to delay return to work, advice to delay return to activity, and a belief that return to work or activity is a threat to the patient (Gardner et al., 2017). To be able to better target training strategies to health care professionals who do not deliver optimal care, validated tools evaluating their attitudes and beliefs are required.

2.8 Tools to assess health care providers' attitudes and beliefs

Several instruments have been developed to evaluate the attitudes and beliefs of health care providers. A critical review of the quality of available measurement tools demonstrated limited reporting of their validity and reliability (Bishop et al., 2007). The reviewers recommended further development and testing of existing tools, rather than developing new measures.

The first measure developed for this purpose was the Healthcare Providers' Pain and Impairment Relationship Scale (HC-PAIRS) (Rainville et al., 1995). This instrument was adapted from a questionnaire for patients' pain beliefs (Riley et al., 1988). It measures the extent to which health care providers believe that pain invariably leads to disability in chronic pain patients. The HC-PAIRS has 15 items and was originally found to cover four dimensions: functional expectations, social expectations, need for cure and projected cognitions. However, a later study proposed a unidimensional solution and deletion of two items (Houben et al., 2004).

The Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) is one of the most widely used and thoroughly tested instruments (Bishop et al., 2007). Ostelo and colleagues developed the PABS-PT to facilitate the assessment of the role of attitudes and beliefs (or treatment orientation) on the development and persistence of chronic LBP (Ostelo et al., 2003). An amended 19-items version of the scale was developed from the original 36 items (Houben et al., 2005b) and has been used in a number of cross-sectional and interventional studies in several countries. A systematic review

concluded that the instrument is still in a developmental stage, but has promising psychometric properties (Mutsaers et al., 2012). Development, testing of psychometric properties and use of the PABS-PT in the research literature will be discussed separately in this thesis.

The HC-PAIRS and the PABS-PT are the two most thoroughly tested instruments, but three other tools have been developed and used to assess health care providers' back pain beliefs (Bishop et al., 2007). The Fear Avoidance Beliefs Questionnaire (FABQ) was originally developed by Waddell (Waddell et al., 1993) to assess the fear avoidance beliefs of patients with back pain. The questionnaire was adapted for use in two studies assessing fear avoidance beliefs of general practitioners and rheumatologists in France (Coudeyre et al., 2006, Poiraudeau et al., 2006). Linton et al. also developed a tool to assess the fear avoidance beliefs of practicing general practitioners and physiotherapists and relate these beliefs to advice to patients, sick-leave prescription and ability to identify risk factors for persistent pain problems (Linton et al., 2002) The instrument was used in one single Swedish study. Finally, the Attitudes to Back Pain Scale in Musculoskeletal Practitioners (ABS-mp), was developed by Pincus and colleagues (Pincus et al., 2006b) using robust methods, including identification of items by qualitative analysis of semi-structured interviews and a questionnaire survey using relevant practitioners (physiotherapists, chiropractors and osteopaths) (Pincus et al., 2006a). The questionnaire sought to assess practitioners' attitudes concerning their role and self-image plus their beliefs about treatment, goals and prognosis of LBP. Factor analyses revealed two subscales with a six- and a two-factor solution. Confirmatory factor analysis showed this model to have a good fit. Face validity was explored in semi-structured interviews with 14 practitioners. In their review of health care provider assessment tools, Bishop and colleagues noted that reliability and validity of the ABS-mp was lacking and further testing was required for this tool to score highly on the quality criteria (Bishop et al., 2007).

2.9 The Pain Attitudes and Beliefs Scale for Physiotherapists

2.9.1 Development of the PABS-PT

The Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) is a self-administrated questionnaire developed to distinguish between physiotherapists with a biomedical and a biopsychosocial treatment orientation regarding LBP (Ostelo et al., 2003, Houben et al., 2005b). It originally consisted of 31 items. Twelve items were retrieved by reviewing existing questionnaires measuring patients' attitudes and beliefs toward LBP and then rephrased to a therapist's point of view. Eight items were collected from the Tampa Scale of Kinesiophobia (TSK) (Kori, 1990), two from the Back Beliefs Questionnaire (BBQ) (Symonds et al., 1996) and two from the Fear Avoidance Beliefs Questionnaire (FABQ) (Waddell et al., 1993). The developers themselves devised 19 items following an expert review procedure using experienced physiotherapists specialized in behavioral therapy and pain management. Two criteria were required; the items should be unambiguous, and they should discriminate between a biomedical and a behavioral treatment orientation.

After being tested on a sample of 421 physiotherapists, the scale was subjected to principal factor analysis, which resulted in a two-factor solution. The biomedical factor consisting of 14 items accounted for 25.2% of the variance and demonstrated good internal consistency (Cronbach's alpha=0.84) The "behavioral" factor consisting of 6 items, accounted for 8.2% of the variance and demonstrated a poor Cronbach's alpha=0.54.

The original 31-items PABS-PT was revised by Houben and colleagues (Houben et al., 2005b), with the aim to strengthen the behavioral subscale. Five items were added to the original pool of items and reviewed by the same expert group. The revised 36-items PABS-PT was evaluated on factor structure, internal consistency and convergent validity. Again, a two-factor structure was found with 10 items in the biomedical subscale explaining 23.4% of the variance with Cronbach's alpha = 0.80, and 9 items in the behavioral subscale explaining 10% of the variance and with Cronbach's alpha = 0.68. Most studies examining the factor structure have confirmed

the two-factor structure, however, with considerable variation in item composition, which makes it difficult to compare and standardize scores. Appendix 3 displays the 36-items pool of the PABS. Table 1 shows which items loaded on the two factors in all studies.

The PABS has also been adapted for neck pain (Mutsaers et al., 2014), whiplash (Rebbeck et al., 2013) and generic musculoskeletal pain (Duncan, 2017). The PABS-PT has since been used in a number of studies to assess physiotherapists', osteopaths', chiropractors' and medical doctors' conceptions of LBP, and to evaluate the impact of educational interventions on health care providers' attitudes, beliefs and treatment behavior. Appendix 5 summarizes the studies evaluating the effect of educational interventions on attitudes and beliefs.

2.9.2 Conceptual model of the PABS-PT

The developers described a biomedical treatment orientation as being derived from a biomechanical model of disease, where pain and disability are considered the consequence of specific pathology or tissue damage. Diagnosis of the pathology provides the basis for treatment. As pain is considered a signal of tissue damage, treatment will probably be adapted to the level of pain. The approach is therefore considered as "pain-contingent". A behavioral or biopsychosocial treatment orientation was described as the physiotherapists' belief in the biopsychosocial model of disease. This model emphasizes that the development and maintenance of pain complaints may be influenced by psychological and social factors. Pain is not necessarily considered to be a sign of biomechanical impairments or tissue damage but may persist after the initial pathology has healed. In a biopsychosocial treatment orientation, treatment is not necessarily adapted to the pain level of the patient but is rather focused on an increase in activity according to a previously defined timeframe. Therefore, this approach is usually considered to be "time-contingent".

Table 1. Items included in the biomedical (A) and biopsychosocial subscale (B) by studies examining the factor structure of the PABS

A. Studies examining the factorial structure	Biomedical Item Pool (item numbers)																
Item number included in the scale	4	5	9	10	13	14	20	22	23	24	25	26	28	29	30	31	35
Ostelo et al. (2003)		5	9	10	13	14	20	22	23	24	25	26			30	31	
Houben et al. (2005)				10		14	20	22	23	24	25				30	31	35
Laekeman et al. (2008)	4	5		10		14			23		25	26			30	31	35
Dalkilinc et al. (2015)			9	10					23	24	25		28			31	
Mutsaers et al. (2014)				10			20		23	24	25			29		31	
Eland et al. (2017)	4	5		10		14	20	22	23	24	25	26			30	31	35
Eland et al. (2016)	4			10		14			23	24					30	31	

B. Studies examining the factorial structure	Biopsychosocial item pool (item numbers)															
Item number included in the scale	3	6	7	11	12	13	15	17	19	20	27	29	30	33	34	36
Ostelo et al. (2003)	3	6	7	11	12						27					
Houben et al. (2005)		6	7	11	12			17			27	29		33	34	
Laekeman et al. (2008)				11					19			29			34	
Dalkilinc et al. (2015)					12	13	15	17		20			30			
Mutsaers et al. (2014)	3	6	7		12			17			27			33		36
Eland et al. (2017)				11	12			17				29		33	34	
Eland et al. (2016)				11	12			17	19			29		33	34	

Items 1,11,13,15,19,20,21,30 are based on the Tampa Scale of Kinesiophobia (Miller et al. 1991). Items 23 and 27 are based on the Back Beliefs Questionnaire (Sullivan et al-1995). Items 9 and 14 are based on the Fear Avoidance Beliefs Questionnaire (Waddell et al. 1993).

2.9.3 Instructions for completion and scoring

Respondents indicate on a six-point Likert scale the extent to which they agree or disagree with each statement. Subscale scores are calculated by a simple summation of the responses to the subscale items. In the 19-item version, biomedical subscale scores may range from 10 to 60 (10 items), the behavioral subscale scores may range from 9 to 54 (9 items). Higher scores on a subscale indicate a stronger treatment orientation. A high score on the biomedical subscale refers to the belief of a relation between pain and damage. A high score on the behavioral subscale refers to the belief that it is possible to overcome functional disability, despite pain (Houben et al., 2005b). The developers of the scale have not established a cut-off point that signifies high or low scores, however, some studies have combined the scores on both subscales to generate categories of extreme attitudes toward either biomedical or biopsychosocial orientations (Bishop et al., 2008, Vonk et al., 2009).

2.9.4 Summary of the psychometric properties of the PABS

A systematic review of the psychometric properties of the PABS-PT found that it has satisfactory internal consistency, good test-retest reliability and that scores are able to predict actual treatment management and advice to patients (Mutsaers et al., 2012). Furthermore, scores seem to be sensitive to change since they are responsive to educational interventions. However, the review concluded that evidence on measurement properties of the PABS-PT, although promising, was lacking and required further investigation of content validity, interpretability and reliability.

Internal consistency

Internal consistency is defined as “the degree of interrelatedness among the items” (Mokkink et al., 2010c) and is a measure of the extent to which items assess the same construct. Cronbach’s alpha is a common parameter for internal consistency and values between 0.70 and 0.90 are recommended (Streiner et al., 2014).

Whereas the biomedical subscale has been shown to be stable and robust with high internal consistency, the behavioral subscale has consistently fallen short of recommended levels of Cronbach's alpha. The reason for this is not clear, but fewer items included in the biopsychosocial subscale may play a role. Homogeneity of responses or an imprecisely demarcated construct are other possible reasons (de Vet et al., 2011, page 138). Values of Cronbach's alpha found in the various studies are summarized in Table 2.

Test- retest reliability

Test- retest reliability is "the extent to which scores for patients (or therapists) who have not changed are the same for repeated measurement over time" (Mokkink et al., 2010). Test-retest reliability has been deemed satisfactory (ICC>0.70) in earlier reviews (Mutsaers et al., 2012, Duncan, 2017) based on findings in four studies (Bowey-Morris et al., 2010, Magalhaes et al., 2011, Mutsaers et al., 2014, Duncan, 2017). Intraclass correlation coefficients (ICC) above 0.70 (varying from 0.73 to 0.81) were reported for the biomedical subscale. ICC's for the biopsychosocial subscale were less consistent, varying from 0.65 to 0.82. Table 3 summarizes the studies reporting on the test-retest reliability.

Measurement error

Three studies reported 95% limits of agreement (LOA, Bland-Altman plots) for the evaluation of systematic differences (Bowey-Morris et al., 2010, Mutsaers et al., 2014, Duncan, 2017). LOA's for the biomedical subscale were found to be larger than those for the biopsychosocial subscale. However, the PABS versions used in these studies deviate from the original Houben PABS version, regarding number of items and content.

Table 2. Comparison of studies assessing structural validity and/or internal consistency of the PABS-PT

	Factor 1 (Biomedical)			Factor 2 (Biopsychosocial)		
	Number of items	Cronbach's alpha	Variance explained	Number of items	Cronbach's alpha	Variance explained
Ostelo et al. (2003)	14	0.84	25.2 %	6	0.54	8.2 %
Houben et al. (2005)	10	0.73	23.4 %	9	0.68	10 %
Laekeman et al. (2008)	10	0.77	21.5 %	4	0.58	3.6 %
Eland et al. (2017)	13	0.79	18.1%	6	0.57	7.1 %
Eland et al. (2016)	10	0.76		9	0.59	
	7	0.67 **		7	0.60 **	
Watson et al. (2008)	12	0.79	--	5	0.60	--
Magalhaes et al. (2011)	10	0.74	--	9	0.67	--
Dalkilinc et al. (2015)	7	0.72	24.5%	6	0.59	14%
Mutsaers et al. (2014)	7	0.75		8	0.73	
Duncan (2017)	10	0.78		(10)*	(0.83)*	(34%)*
Chiarotto et al. (2018)	10	0.78**				

*New biopsychosocial subscale for generic musculoskeletal pain PABS-MSK, Duncan, 2017). ** Data from IRT (Chiarotto et al., 2018) and Rasch analysis (Eland et al., 2017).

Four studies reported on the standard error of measurement (SEM) and the smallest detectable change (SDC) of the PABS scores (Bowey-Morris et al., 2010, Magalhaes et al., 2011, Mutsaers et al., 2014, Duncan, 2017), see Table 3

Table 3. Studies reporting on the test-retest reliability of the PABS.

		Biomedical subscale				Biopsychosocial subscale			
	PABS version	ICC (CI 95%)	95% LoA	SEM	SDC	ICC (CI 95%)	95% LoA	SEM	SDC
Bowey-Morris et al. (2010)	17 items version for general practitioners	0.81 (0.71-0.88	-8.9 to 8.6	3.13	8.66	0.65 (0.50 - 0.77	-4.5 to 3.8	1.47	4.09
Magalhaes et al. (2011)	19 items Houben version	0.80 (0.72-0.87)		3.5		0.70 (0.57-0.94)		3.5	
Mutsaers et al. (2014)	15 items version for neck pain	0.73 (0.56-0.83)	-11.9 to 11.0	3.0	8.3	0.82 (0.71-0.89	-7.3 to 7.4	1.6	4.4
Duncan (2017)	10-items MSK version	0.74 (0.65-0.82	-10.42 to 9.72	3.63	5.28				

ICC=Intraclass Correlation Coefficient; LoA= Limits of Agreement; SEM=Standard error of measurement; SDC=Smallest Detectible Change

Content validity

Content validity is "the degree to which the content of a measurement instrument is an adequate reflection of the content to be measured" (Mokkink et al., 2010c). No formal assessments of the PABS' content validity has been performed. Content validity is recommended to be assessed qualitatively in the development process by performing cognitive interviews of potential users and/or experts in the field (Terwee et al., 2018b). Alternatively, a survey can be performed. The developers of the scale used an expert panel of experienced cognitive behavioral orientated physiotherapists to select unambiguous items that seemed adequate to discriminate between biomedical and biopsychosocial treatment orientation (Houben et al., 2005b, Ostelo

et al., 2003). Later studies assessing the validity of the PABS have relied on pre-survey pilots to test the format and acceptability of the questionnaire (Laekeman et al., 2008, Simmonds et al., 2012, Dalkilinc et al., 2015, Magalhaes et al., 2011).

Structural validity

Structural validity is "the degree to which the scores of a measurement instrument are an adequate reflection of the dimensionality of the construct to be measured" (Mokkink et al., 2010c). Most validation studies confirmed the two-factor structure of the PABS-PT using exploratory factor analysis (EFA) of the 31-items or the 36-items versions (EFA) (Ostelo et al., 2003, Houben et al., 2005b, Laekeman et al., 2008, Dalkilinc et al., 2015, Mutsaers et al., 2014), however, all produced subscales of different length and composition (Table 1). Brunner and colleagues used EFA for the 36-items German version and confirmatory factor analysis (CFA) for the 17 items version (Brunner et al., 2019). This study found 8 factors and did not confirm the two-factor structure. The authors recommend caution when using the PABS-PT. One other study used item response theory (IRT) to examine the English 10 items biomedical subscale (Chiarotto et al., 2018a) and found adequate fit and adequate psychometric properties in a unidimensional subscale.

Cross-cultural validity

Cross-cultural validity is "the degree to which the performance of the items on a translated or culturally adapted measurement instrument are an adequate reflection of the performance of items in the original version of the instrument" (Mokkink et al., 2010c). Most cross-cultural validation studies used a forward-back translation procedure (Beaton et al., 2000). The English version was not produced in a formal cross-cultural adaptation procedure, but published in the development papers (Ostelo et al., 2003). The PABS-PT has been translated into German (Laekeman et al., 2008), Brazilian-Portuguese (Magalhaes et al., 2011), French (Simmonds et al., 2012), Turkish (Dalkilinc et al., 2015), Swedish (Overmeer et al., 2009), Japanese (Takasaki et al., 2014) and Hebrew (Roitenberg, 2019). Some translations did not follow a cross-cultural adaptation procedure (Overmeer et al., 2009, Roitenberg, 2019).

Construct validity

Construct validity is "the degree to which the scores of a measurement instrument are consistent with hypotheses, based on the assumption that the instrument validly measures the construct it purports to measure" (Mokkink et al., 2010c). Hypothesis testing is one aspect of construct validity testing and concerns the relationship of scores on the instrument with scores of other instruments measuring similar constructs (convergent validity), dissimilar constructs (discriminant validity) or differences in scores between relevant subgroups (discriminative validity) (de Vet et al., 2011).

Convergent and discriminative validity have been assessed by examining the relationship between PABS scores and clinical behavior, and their correlations with scores on related questionnaires and with demographic or professional characteristics of responders. Scores on both subscales were found to be significantly associated with certain clinical practice behaviors (Bishop et al., 2008, Houben et al., 2005b, Derghazarian and Simmonds, 2011, Laekeman et al., 2008, Fullen et al., 2011). These clinical behaviors were measured with vignettes of patients with low risk or moderate risk for chronification of LBP. Clinicians were asked to indicate the level of severity of the pathology, the risk of developing CLBP, and the advice to return to work and to normal activity. Higher scores on the biomedical subscale and lower scores on the behavioral subscale were found to be highly associated with an inclination to recommend delay of return to work and normal activity, with correlation coefficients ranging from r=0.08 to 0.40 (Derghazarian and Simmonds, 2011, Houben et al., 2005b).

Scores of the PABS-PT have been found to be highly and significantly associated with the scores of some other measurement tools assessing similar constructs. Such instruments were the Tampa Scale for Kinesiophobia for Health Care Providers (TSK-HC) (Haugen et al., 2008), the Back Beliefs Questionnaire (BBQ) (Symonds et al., 1996) and the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) (Rainville et al., 1995, Houben et al., 2005b).

Furthermore, the PABS was found to be able to discriminate between physiotherapists with a biomedical orientation versus those with a behavioral orientation (Ostelo et al., 2003). Biomedically trained heath care providers (like osteopaths, chiropractors and manual therapists) scored higher on the biomedical scale than those who had attended biopsychosocial courses (Ostelo et al., 2003, Rebbeck et al., 2013). Clinicians who had followed biopsychosocial training (e.g. cognitive behavioral management and psychologically informed physiotherapy), were found to score more highly on the biopsychosocial scale (Beneciuk and George, 2015, Jacobs et al., 2016). This indicates that the PABS-PT is sensitive to change in treatment orientation.

Scores on both subscales of the PABS-PT have been found to be significantly predictive of therapists' perceptions of the harmfulness of daily physical activities, as measured by the Photographic Series of Daily Activities (PHODA) (Houben et al., 2005b). Responders' scores were also predictive of their recommendations regarding return to work and daily physical activities (Houben et al., 2005b, Derghazarian and Simmonds, 2011).

Construct validity of the PABS-PT was rated as positive in a critical review of its measurement properties (Mutsaers et al., 2012), although formal and robust hypothesis testing remained to be done.

Responsiveness

Responsiveness is "the ability of an instrument to detect change over time in the construct to be measured" (Mokkink et al., 2010c). One study has examined the sensitivity to change (Bowey-Morris et al., 2010), but no studies have compared changes in PABS scores with a criterion instrument or subjected the scale to hypothesis testing with a priori formulation of the direction or magnitude of change scores (de Vet et al., 2011). Several studies have assessed the impact of educational interventions on PABS scores in pre-post-tests (Overmeer et al., 2009, Beneciuk and George, 2015, Beneciuk et al., 2019, Jacobs et al., 2016, Overmeer et al., 2011, Jellema et al., 2005, Vonk et al., 2009). An impression of the magnitude of score

changes can be distracted from these studies. Generally, biomedical change scores were larger than biopsychosocial change scores, but most were statistically significant. Changes in biomedical scores varied across these six studies from 4 to 8 points (median 5 points), and changes in biopsychosocial scores varied from 0.7 to 5.5 (median 3 points). Two studies reported large effect sizes for both subscales varying from d=0.89 (Jacobs et al., 2016) to d=2.86 (Beneciuk and George, 2015), whereas one study reported small effect size (d<0.2) (Montesinos et al., 2019). However, effect sizes and p-values are inappropriate measures of responsiveness (de Vet et al., 2011).

Interpretability

Interpretability is the degree to which it is clear what the scores or change scores mean. Interpretability of PABS scores has not been examined, however, one study examined the sensitivity to detect change of PABS scores after an educational intervention by using paired t-tests and change outside the 95% limits of agreement (LOA) or above the smallest detectible change (SDC) (Bowey-Morris et al., 2010). In their sample of 73 general practitioners, only biomedical scores were found to fall outside the LOA.

2.10 Is a tool to measure attitudes and beliefs of back pain needed in Norway?

A Norwegian version of the Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) was needed, as there was an obvious lack for a valid instrument to measure physiotherapists' back pain beliefs in the Norwegian language. The PABS was chosen because of its ability to differentiate between a biomedical and a biopsychosocial treatment orientation. Previous research in Norway had a different focus on the evaluation of health care providers' attitudes and beliefs. A large survey in Norway in 2001 concluded that Norwegian general practitioners and physiotherapists had perceptions on back pain care that were consistent with the "new

back pain revolution", as most of them did not agree on Deyo's "seven myths on back pain" (Deyo, 1998, Ihlebaek and Eriksen, 2004). Four years later, after a LBP mass media campaign with an educational initiative, no important improvements in LBP beliefs of health care providers were observed (Werner et al., 2008). A third survey in 2011 found that general practitioners treated their patients with LBP the same way as they did in 2001 (Werner and Ihlebaek, 2012). However, although attitudes seemed unchanged and were in harmony with clinical guidelines, important differences were found in the back-pain beliefs of physiotherapists, general practitioners and chiropractors (Werner and Indahl, 2005). An interesting finding was that although Norwegian physiotherapists demonstrated attitudes and knowledge in accordance with clinical guidelines, 41% of them had the opinion that patients suffering from LBP should listen to their body and avoid everything that provokes pain. A significant lower percentage of physicians and chiropractors sustained the same opinion (Werner and Indahl, 2005). Similar attitudes were found in a qualitative study of Norwegian manual therapists who advised some of their patients to avoid painful movements, but first of all adjusted their treatment in accordance with the individual patients' problem and context, depending on the presence of avoidance or endurance (Strand et al., 2005). Apparently, therapists can hold beliefs based on contradictory biomedical and biopsychosocial perspectives at the same time and change their approach when necessary (Brown, 2009, Plaas et al., 2014). As apparent changes in attitudes seem to be more subtle than presumed previously, there was a need for a valid and precise instrument to measure physiotherapist' attitudes and beliefs. The PABS seemed most appropriate for that purpose.

3. Aims of the studies

3.1 Overall aim of the PhD thesis

The overall aim of the thesis was to develop a Norwegian version of the PABS-PT with satisfactory reliability and validity to measure physiotherapists' attitudes, beliefs and treatment orientations regarding back pain for use in clinical and educational evaluative and outcome research.

3.2 Specific aims of the four studies

- The aim of Study I was to translate the PABS-PT into Norwegian from the original Dutch 36-items version and examine the underlying dimensionality and internal consistency.

- The aim of Study II was to examine the internal construct validity and reliability of the Norwegian version of the PABS-PT using Rasch model analysis and, if possible, to improve its scale- and item performance.

- The aim of Study III was to examine the discriminative validity of the Rasch modified Norwegian version of the PABS-PT by comparing subgroups of physiotherapists with known differences in treatment orientation.

- The aim of study IV was to explore the content validity of the PABS-PT qualitatively by assessing the relevance, comprehensibility and comprehensiveness.

4. Materials and Methods

4.1 Design

The thesis includes both quantitative and qualitative research. Whereas quantitative research typically implies collecting numerical information and describing results in statistical terms, qualitative research implies collecting data by means of interviews and/or observation and describing results in interpretive narratives (Carter and Lubinsky, 2015, page 171).

First, in Study I, the original 36 items Dutch version of the PABS-PT was translated in a forward and backward translation procedure, following international guidelines (Beaton et al., 2000). Quantitative data for Studies I, II and III were collected in a cross-sectional web-based survey of Norwegian physiotherapists, following guidelines for the design of web-based surveys (Eysenbach, 2004, Dobrow et al., 2008). Qualitative data for Study IV were collected in an individual cognitive interview study of physiotherapists, following the checklist approach of the Cognitive Interviewing Reporting Framework (CIRF) (Boeije and Willis, 2013) and the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) standard for evaluating the quality of content validity studies of patient reported outcome measures (PROMs) (Terwee et al., 2018a).

4.2 Translation and cultural adaptation of the PABS-PT

Cultural adaptation of a questionnaire for use in a new country intends to reach equivalence between the original source and target versions of the questionnaire. (Beaton et al., 2000). A cross-cultural adaptation process tries to produce both semantic, idiomatic, experiential and conceptual equivalency of the items' content. However, an accurate translation does not guarantee a retention of the instrument's

measurement properties (Beaton et al., 2000). Therefore, additional validation is needed to ensure that the adapted instrument measures a construct comparable to the original (de Vet et al., 2011).

4.2.1 The translation process

The translation process consisted of six steps (Beaton et al., 2000). In Step 1, two bilingual Norwegian physiotherapists and a Dutch professional translator produced a forward translation each. In Step 2, consensus was reached between the translators about a synthesis of the forward translation. In Step 3, an expert committee consisting of three physiotherapists (one native Dutch and two with extensive experience in clinimetric research), produced a pre-final version after review of all translations, including the English version of PABS. In Step 4, two back translations were produced by two bilingual Dutch physiotherapists. In Step 5, the pre-final version was sent to a sample of 21 physiotherapy researchers at the University of Bergen to test the comprehensibility and applicability of the questionnaire. In the final Step 6, appraisal of the adaptation process and the back translations were obtained from the developers.

A written report documented the issues encountered and the decisions made in the review by the expert committee. Nineteen of the questionnaire's 36 items were without any changes or modifications. Twelve items required minor grammatical or idiomatic corrections. The expert committee met challenges regarding 5 items, mainly because of discrepancies in content and meaning between the original Dutch version and the published English version.

4.3 Respondents and participants

Physiotherapists in our survey were called respondents. Physiotherapists in our interview study were called participants. In Paper I, II and III we describe

demographic and professional characteristics of the responders in detail. In paper VI, only global information was reported regarding our participants for anonymity reasons.

4.3.1 The target population of physiotherapists in Norway

The target population of physiotherapists in Norway encompasses general physiotherapists and four specialized physiotherapy groups: physiotherapy specialists, manual therapists, osteopaths and psychomotor physiotherapists. In January 2019, 13.104 chartered physiotherapists were registered working in Norway, of whom 3.783 were working in private practice (source Statistics Norway, http://www.ssb.no/). The various specialties and professional differences within Norwegian physiotherapy are shortly outlined below.

Physiotherapy specialists

In 2011, the Norwegian Association of Physiotherapists (NAP) had conferred specialist titles of postgraduate competence to 650 physiotherapists in 13 areas of postgraduate competence. We included four specialties in our survey: General practice-, Sports-, Orthopaedic- and Rheumatologic physiotherapy, as other specialties such as Oncology-, Paediatrics- and Neurology were assumed to be less informative for our research on back pain beliefs.

Manual therapists

In February 2020, there were 684 extended scope manual therapists in Norway (source: NAP, Norwegian Directorate of Health). At the time of the survey, there were approximately 470 manual therapists working in private practice in Norway (source: www.helfo.no). Manual therapists have a “gate keeper” function in Norwegian primary health care. They provide sickness certification up to 12 weeks and can refer their patients to specialist medical care, if deemed necessary.

Osteopaths

The number of osteopaths working in Norway is unknown. However, in 2012, 153 osteopaths were listed on the website of the Norwegian Osteopath Association. Osteopathy is not part of regular health care in Norway and therefore not refunded by the Norwegian Health Service. Most osteopaths are private practicing physiotherapists who have attended a 3-years bachelor program in osteopathy.

Psychomotor physiotherapists

In December 2011, there were approximately 425 psychomotor physiotherapists in Norway (data from NAP-www.fysio.no). Norwegian Psychomotor Physiotherapy, or Psychosomatic and Psychiatric Physiotherapy, represents a long-standing tradition within physiotherapy in Norway. Psychomotor physiotherapists work from a psychological and phenomenological perspective, emphasizing the close connection between thoughts, emotions and the lived body. According to the tradition, tensional changes in the body may have an effect on a variety of other body regions and functions. Therefore, examination and treatment include the whole body. Psychomotor physiotherapists focus on the patient's emotions and experiences and on bodily flexibility and ability to relax, with an emphasis on muscular tension, posture and respiration (Dragesund and Raheim, 2008, Dragesund and Kvale, 2016).

4.3.1 Recruitment of the study sample for the survey

Two samples of convenience were created for our survey. Sample 1 was recruited by the Norwegian Association of Physiotherapists (NAP) and sample 2 was recruited by us, from membership lists publicly available on the Internet.

Sample 1

The Norwegian Association of Physiotherapists (NAP) is the professional and trade union body with 9724 members (January 1. 2019), representing approximately 85% of all chartered physiotherapists in Norway.

In February 2012, the NAP sent e-mail invitations to 2860 physiotherapists in the counties of Nordland, Sør-Trøndelag, Hordaland and Oslo. The invitation contained a hyperlink to the website of the survey instrument SurveyMonkey (www.surveymonkey.com). The distribution of specialties and professional background in Sample 1 was unknown for us, however, based on the geographic distribution, we knew that Sample 1 should include approximately 75 manual therapists, 110 psychomotor physiotherapists and 30 physiotherapy specialists.

Sample 2

Names and e-mail addresses of 989 physiotherapists with a specialist background were extracted from membership lists on the websites of their trade union: Norwegian Associations of Physiotherapists (NAP), the Association of Manual Therapists and the Norwegian Osteopath Association and transferred to SurveyMonkey.

In February 2012, e-mail invitations were sent to 85 physiotherapy specialists, 387 manual therapists, 127 osteopaths and 390 psychomotor physiotherapists. Two reminders were sent after 2 and 4 weeks to all non-responders. The survey was closed in April 2012.

4.3.2 Recruitment of participants for the cognitive interview study

According to Patrick et al., it is advisable to recruit participants who would be considered typical or generally representative of the target population, as well as being a purposive sample of those who may have unique responses or perspectives (Patrick et al., 2011b).

For Study IV, personal inquiry and snowball sampling were used for recruitment of a sample of eleven Norwegian physiotherapists. We sought for variation in professional background, age and gender. General physiotherapists, manual therapists, specialist physiotherapists and psychomotor physiotherapists (6 females and 5 males with ages ranging from 24 to 70 years) were recruited based on accessibility. Before starting recruitment, we performed a pilot interview to test the applicability of the Three Step

Test Interview and the interview guide. The pilot interview of this participant (participant A) was not included in our analysis.

Willis (Willis, 2005) suggested that 7-10 interviews are sufficient to confirm understandability of the item, but Patrick (Patrick et al., 2011b) noted that the number of interviews needed is dependent on the complexity of the instrument and the diversity of the population of interest. Before recruitment, we decided to emphasize diversity of opinions and variation of professional background among participants, because we considered our study aim to be narrow.

4.4 Data collection

In Study I, quantitative data was collected in a cross-sectional survey. The surveyed data were used in Study I, II and III. In study IV, qualitative data was collected with cognitive interviewing. The Three-Step Test Interview technique was chosen for this purpose.

4.4.1 Quantitative data collection: the survey

We developed an online questionnaire with two sections. The first section addressed demographic and practice issues and the second section comprised the 36 item Norwegian version of the PABS-PT.

Collection of demographic and practice data

On entering the questionnaire, a filter question disqualified those respondents who had not treated at least one patient with LBP in the previous 6 months. In this, we followed Bishop et al. in their large study on health care providers' attitudes and beliefs in the UK (Bishop et al., 2008). The complete questionnaire is displayed in Appendix 1.

In formulating the demographic and practice questions, we followed those included in previous studies of health care providers' attitudes and beliefs (Ostelo et al., 2003, Houben et al., 2005b, Houben et al., 2005a, Laekeman et al., 2008, Werner et al., 2008, Watson et al., 2008), but one question had not previously been used. The respondents were asked to describe their own treatment approach, the four response options being: (1) focused on pain relief, (2) focused on a prearranged time-frame for treatment, (3) focused on impairment-level achievement and (4) focused on functional recovery of activities and work tasks. Options 1 and 2 were considered to represent a pain-contingent and a time-contingent approach, respectively. Options 3 and 4 were added because physiotherapists not only focus on pain, but also on levels of functionality and disability. Option 3 (prioritization of recovery of bodily functioning, like strength, mobility and motor control) was meant to represent the more biomedical oriented "Body Component" of the International Classification of Functioning, Disability and Health (ICF). Option 4 (prioritization of restoration of work tasks and daily activities) was meant to represent the more biopsychosocial oriented "Activity and Participation Component" of the ICF (WHO Organization, 2001).

The instrument: The Pain Attitude and Beliefs Scale for Physiotherapists

In the introduction to the PABS-PT, the respondents were informed on the purpose of the questionnaire and instructed on its completion. The complete set of 36 items was included in the questionnaire to explore the factor structure of the PABS. as the scale was still in a developmental stage. Furthermore, all items were included because responses on certain items might prompt responses on other items.

4.4.2 Qualitative data collection: Cognitive interviews

Cognitive interviewing applies qualitative research methods to identify problems in survey items and to understand how an item works and "what it captures" (Boeije and Willis, 2013). We used a combination of (concurrent) think-aloud and (retrospective)

verbal probing, both being effective for this purpose (Willis, 2005) but most efficient when combined (Conrad et al., 1999).

Cognitive interviews have two aims: Firstly, to assess the participants' comprehension of the questionnaire items in relation to their intended meaning, including the identification of any format or wording problems or problems with the instructions or response options. Secondly, to evaluate comprehensiveness of content by checking that no important items evaluating the targeted concept are absent (Patrick et al., 2011b).

Theoretical framework of cognitive interviewing

The theoretical framework underlying cognitive interviewing was developed by Tourangeau (Tourangeau, 1984), which is a survey response process model explicating four major cognitive processes presumed to occur in the participant's mind when answering survey questions: Comprehension, Retrieval, Judgement and Response. Later improvements of this classical cognitive model have stressed the importance of the participants' motivation or amount of effort applied to the answering task (Boeije and Willis, 2013, Patrick et al., 2011b, Fowler Jr et al., 2016). Furthermore, it is now recognized that a question is answered in a situational or life context, and not only in an interaction with the survey question (Boeije and Willis, 2013).

The Tree-Step Test Interview

In Study VI, we used the Tree-Step Test Interview (TSTI) method, introduced by Hak et al. (Hak et al., 2008), which is considered to be the most systematic hybrid approach to the cognitive evaluation of self-administered questionnaires. The method has been highly recommended to examine content validity (de Vet et al., 2011, Terwee et al., 2018a) and has been used in several other studies (Pool et al., 2009, Pool et al., 2010, Boeije and Willis, 2013, Bode and Jansen, 2013, Paap et al., 2016). The TSTI encompasses three consecutive phases: (1) a concurrent thinking aloud

phase; (2) a retrospective probing phase; and (3) a semi-structured interview. The procedure of the TSTI was documented in the interview guide (Appendix 4).

The think-aloud part of the interview is a challenging cognitive task for participants when they are asked to verbalize their thoughts and to articulate how they make sense of the questionnaire items. Furthermore, the think-aloud process has been found unnatural and difficult by many participants (Patrick et al., 2011a). The major advantage of the think-aloud procedure is that it reduces interviewer-imposed bias. On the other hand, Willis (Willis, 2005) recommends not to utilize think-aloud without supplemental interviewer-based verbal probing.

Verbal probing and semi-structured interviews encompass in-depth questions about the relevance and understanding of the items, the complexity of the questionnaire and aspects of the concept that are not covered (Patrick et al., 2011b). Verbal probing requires a more thoughtful approach toward the participants, with the risk of promoting unreliable answers (Willis, 2005).

4.5 Data Analysis

Descriptive statistical analysis was applied to the demographic and practice variables of the survey respondents in Study I. In Study II, only gender, age and professional background/specialty were used as person factors in the Rasch model analysis, to examine differential item functioning (DIF). In Study III demographic and practice variables played a central role in the formulation of hypotheses on expected differences between subgroups of physiotherapists. All but three demographic variables were used in generating hypotheses. The variables weekly workload, practice settings and reported interest in LBP management were not included in analysis.

Quantitative analysis (Studies I, II and II) and qualitative analysis in Study VI are described in detail below.

4.5.1 Paper I: Exploratory Factor Analysis and Internal Consistency

Analysis involved examination of demographic variables, response rates and comparison of responders who had completed the entire PABS-PT with those who had not or only partially filled out the PABS-PT. Comparison was done with Chi-square statistics. Subsequently, the data were then subjected to factor analysis. Internal consistency was assessed by calculation of item-total correlations and Cronbach's alpha.

Exploratory factor analysis

We conducted an exploratory factor analyses of the responses on the 36-items version of the PABS. Factor analysis is essentially a "data reduction" technique used in scale development: factor analysis serves to refine and reduce a large number of items to form a smaller number of coherent subscales that represent different constructs or factors (Pallant, 2013, Streiner et al., 2014). De Vet et al. explain the principles of factor analysis as follows:

"Factor analysis is based on item correlations. Items that correlate highly with each other are clustered in one factor, while items within one factor should show a low correlation with items belonging to other factors. The items clustered in one factor share variance, which is explained by the underlying dimension. With factor analysis, we try to identify these factors and explain as much as possible of the variance with a minimum number of factors" (de Vet et al., 2011, page 73).

The Principal Axis Factor Analysis (PAF) with an Oblique rotation (Oblimin with Kaiser normalization) was chosen because the same procedure was used by the developers of the scale (Ostelo et al., 2003), and others examining the factor structure of the PABS-PT (Houben et al., 2005b, Laekeman et al., 2008, Brunner et al., 2019, Dalkilinc et al., 2015). Oblique factor rotation by using the oblimin criterion might have been chosen by the developers because this procedure allows the factors to be correlated, which they most often are (Pallant, 2013, Streiner et al., 2014).

Exploratory factor analysis was performed after first confirming that the data was suitable for factor analysis. We followed the same procedure as other studies exploring the factor structure of the PABS.

1. We checked for heterogeneity and removed items with a Skewness and Kurtosis that were not between -1.5 and +1.5, or if more than 75% of the scores were located in extreme response categories. “Extreme scores” were defined as scores 1 or 2 for disagreement and score 5 and 6 for agreement.

2. We calculated the Kaiser-Meyer-Olkin (KMO) coefficient to verify sampling adequacy, which should be ≥ 0.6

3. We calculated the Barlett test for Sphericity, which should be significant ($p<0.05$).

The number of factors to be retained was guided by three decision rules:

1. The item loading on the different factors (Kaiser's criterion: eigenvalues > 1)

2. Inspection of the screeplot

3. Using Horn's parallel analysis (software: MonteCarlo PCA for parallel analysis developed by Watkins 2000, in Pallant, 2010).

Factors were extracted until the eigenvalue dropped below 1 (Kaiser’s criterion) or until the eigenvalue hardly changed between two subsequent factors. The scree plot was used to identify the break between the factors with relatively large eigenvalues and those with smaller eigenvalues (See Appendix 7). Items with a factor loading below 0.25 were excluded. If loading on one factor exceeded 0.25, but the difference between loadings on two factors was less than 0.1, items were also excluded.

Parallel analysis is considered to be one of the most accurate approaches to estimate the number of components (Pallant and Bailey, 2005). In parallel analysis, the size of eigenvalues obtained from factor analysis is compared to those obtained from a randomly generated data set of the same size. Only factors with eigenvalues

exceeding the values obtained from the corresponding random data set are retained for further investigation. For an easy interpretation of the factor structure, strong loadings on few and distinct factors are hoped for. However, interpretation is mainly based on common sense, taking the content of the items and the underlying theoretical concept into consideration (Pallant, 2013). A substantial number of respondents are needed in factor analysis. Numbers of 4 to 10 persons per items has been recommended with a minimum of 100 persons (de Vet et al., 2011, page 80), Streiner et al., 2014).

Internal consistency

Internal consistency was assessed by calculating Cronbach's alpha (de Vet et al., 2011). Item-total correlations indicate whether the item is part of the scale. According to de Vet et al., items with an item-total correlation of less than 0.3 do not contribute much to the discrimination of persons with different levels on the construct under study (de Vet et al., 2011, page 81). Streiner and Norman (Streiner et al., 2014) suggest that item-total correlations should be above 0.20 and that items with lower correlations should be discarded (Streiner et al., 2014). Cronbach's alpha was also used for item reduction. The impact on the alpha value of deleting separate items from the factor (alpha if item deleted) was examined for that purpose. Finally, a Pearson's correlation coefficient was calculated between the factors.

4.5.2 Paper II. Rasch model analysis

In Study 2, we compared the response data of our survey with the unidimensional Rasch measurement model and assessed how the items perform to find out whether it is appropriate to summarize items to create a total (subscale) score. If the PABS data were found to fit the Rasch model, the instrument is expected to be able to measure persons on a linear scale with interval level units (logits).

Rasch measurement theory underlines the relationship between the person's ability and the items' difficulty in measurement (Rasch, 1980, Andrich and Marais, 2019,

Christensen et al., 2013, Bond and Fox, 2015). The required stochastic ordering for this has two important presumptions:

1. Any person should always have a greater probability of receiving a higher score on an "easier" item than on a more "difficult" item.

2. Persons with a high level of the trait, should have a greater probability of receiving a higher score on any item compared to persons with lower levels

Fit to the Rasch measurement model implies that the scale is unidimensional and has a hierarchical and invariant ordering of item difficulty. Each item should provide independent (not redundant) information on the trait to be measured. A distinct feature of the Rasch measurement model is that items and persons can be calibrated on a common linear scale (see figures 1 and 2). Item difficulties and person abilities (proficiencies) are described as locations on the continuum in logits, representing real interval-level measurement. Consequently, persons are characterized by their location on the scale and not by summarized ordinal raw scores. This implies that they can be compared more accurately and that the use of parametric statistics is justified in assessing persons' changes in proficiency (Belvedere and de Morton, 2010, Andrich and Marais, 2019, Tennant and Conaghan, 2007, Hagquist et al., 2009). Deviation of the data from the Rasch measurement model is considered as anomalies or misfits that must be explained and can be a reason for improvement of the instrument. Misfit can be found as invariance in item functioning (differential item functioning, DIF) or invariance in the items' response categories (Bond and Fox, 2015, Christensen et al., 2013).

Analyses were performed using Rasch Unidimensional Measurement Model software (RUMM2030), using the Rasch Partial Credit Model (Andrich et al., 2009., Pallant, 2014). Before Rasch analysis, all 36 items of the PABS were subjected to exploratory factor analysis (principal component analysis). We reasoned that items discarded prior to factor analysis in Study I because of skewness or extreme scores, might contribute to measurement after all (Clark and Watson, 1995), providing valid scores at the extremes and extending the range of coverage on the construct (Tennant et al.,

2004). Factor analysis yielded 20 biomedical and 16 biopsychosocial items. Next, four sets of items were separately subjected to Rasch model analysis: the biomedical and biopsychosocial "Houben version" subscales (called BMS-10 and BPSS-9, respectively), a 20-items extended biomedical item set (called BMIS-20) and a 16-items extended biopsychosocial item set (called BPSIS-16). Analysis involved testing of item- and person invariance, local dependency and unidimensionality in a series of fit statistics described below and summarized in Table 4.

Overall model fit

Overall model fit was evaluated with Item-trait interaction statistics using chi-squared statistics, assessing whether the hierarchical ordering of the items varied across the trait. The requirement of invariance is compromised if this hierarchy is disordered.

Individual person fit

Individual person fit was assessed by inspection of standardized fit residuals. Fit residuals are the difference between observed and expected scores. Misfitting (extreme) persons may skew the analysis because of their abnormal response pattern. Misfitting persons may need to be removed from the analysis. Alternatively, misfitting person need closer (clinical) examination, as they are behaving differently regarding the construct that is being measured, compared to other persons.

Individual item fit

The fit of each individual item to the Rasch model is assessed with chi-square probability, fit residuals and F-statistics. Redundancy of items may be identified by high negative residuals, equivalent to high item-total correlations in classical test theory.

Response threshold ordering

Response categories in each item should reflect a logical and ordered progression of the underlying trait. A threshold is the point between two categories in which there is 50% change to choose the one or the other. Disordered thresholds may occur when

responders cannot reliably distinguish between the presented categories. Ordered response thresholds are a prerequisite to obtain reliable parameter estimates. Therefore, disordered items were rescored by collapsing the categories before any other attempts to improve the scale (Tennant and Conaghan, 2007, Linacre, 2002).

Differential item functioning

Differential Item Functioning (DIF) by gender and age was tested. Closer examination of DIF is necessary when subgroups of respondents (e.g. males and females or older and younger persons) with the same level of the trait, respond to items differently, possibly violating the requirement of invariance. DIF can be adjusted by "splitting for DIF": The item is split into two items, for example one for females and one for males. Each item is then specific to the group in question.

Reliability

The Person-Separation-Index (PSI) is an indication of the power of the construct to discriminate among the respondents. The minimum accepted level is 0.70, indicating that two groups of persons can be differentiated. Levels above 0.90 are necessary to differentiate between two individuals. The PSI is comparable to Cronbach's alpha in classical test theory.

Local response dependency

Responses of persons to an item should depend on their trait level and not on their responses to other test items (Marais, 2013). Each item on a scale should give independent information that is related to the construct. Local response dependency means that responses to one item determines the response to another item and is a source of misfit as it may artificially inflate reliability. Local dependency between items was identified through a residual correlation matrix. Local response dependency can be accommodated for by grouping items together into "testlets "or "super items". This eliminates the dependent relationship between items, but does not change the total raw score derived from the items (Wainer and Kiely, 1987).

Sometimes, all items are grouped into testlets; this is formally equivalent to a bifactor solution (Reise et al., 2011).

Unidimensionality

Smith's test of unidimensionality (Smith, 2002) implies that the responses to two subsets of the most divergent items are compared regarding the person estimates. If the scale is unidimensional, there should be no difference in estimates of person abilities between the subsets of items. The two subsets of person location estimates were compared via an independent t-test. T-tests were performed for each individual person. The number of significant t-tests were counted and no more than 5% of cases should fall outside of the acceptable significance range to support unidimensionality.

Targeting of persons and items

A person-item threshold distribution histogram shows groups of persons with their ability levels and the item locations and their distribution on the same linear scale (Fig 1). The graph informs about the suitability of the sample for evaluating the scale and the suitability of the scale for measuring the sample.

Scale improvement

Two strategies were available for scale improvement, resolution A and resolution B (Horton et al., 2014). In resolution A, attempts were made to correct the misfit, while maintaining as many original items as possible. If necessary, items were re-scored for ordering of thresholds, testlets were created to account for local response dependency and items were split when DIF was identified. In an iterative process, items were corrected, removed and reintroduced, until fit to the Rasch model was obtained. In resolution B, misfitting item were removed in succession to obtain a pure set of items that satisfied all fit parameters. Next, items were reintroduced one by one in an iterative process until fit to the Rasch model was evident.

The two subscales of the Houben version (BMS-10 and BPSS-9) were analysed using both resolution A and resolution B. The two extended subscales were analysed with resolution B only.

Table 4. Summary of fit statistics in Rasch model analysis

Assessment	Analysis	Fit requirement
Overall data fit	Non-significant chi-square Bonferroni adjusted	Hierarchical, invariant ordering of items
Individual person fit statistics	Standardized fit residuals between +2.5 and -2.5, equivalent to 99% confidence interval. Non-significant chi-square probability value	Residuals> 2.5: misfit of person
Item fit statistics	Standardized fir residual between +2.5 and -2.5 Non-significant chi-square probability values	Residuals> 2.5: misfit of item Residuals < -2.5: redundancy of item
Mean of all person fit residuals		Preferably 0 with SD close to 1 and less than 1.40
Mean of all item fit residuals		Preferably 0 with SD close to 1 and less than 1.40
Local response dependency	Inspection of residual correlation matrix between all items	Local dependency if residual correlations between two items > 0.2 above the average residual correlation of all items
Unidimensionality	t-test of individual ability estimates in two diverting samples	Unidimensionality if less than 5 % of t-tests were significant
Differential item functioning (DIF)	Comparison of the responses of two subgroups with the same proficiency	
Person separation index (PSI)	Equivalent to Cronbach's alpha for internal consistency	PSI > 0.70 for group-level comparison PSI > 0.80 for individual comparison
Targeting of person nd items		Means of person locations and item locations should be close to 0 with SD 1.
Response Threshold Ordering	Identification of disordered thresholds	Rescoring of items by collapsing response categories

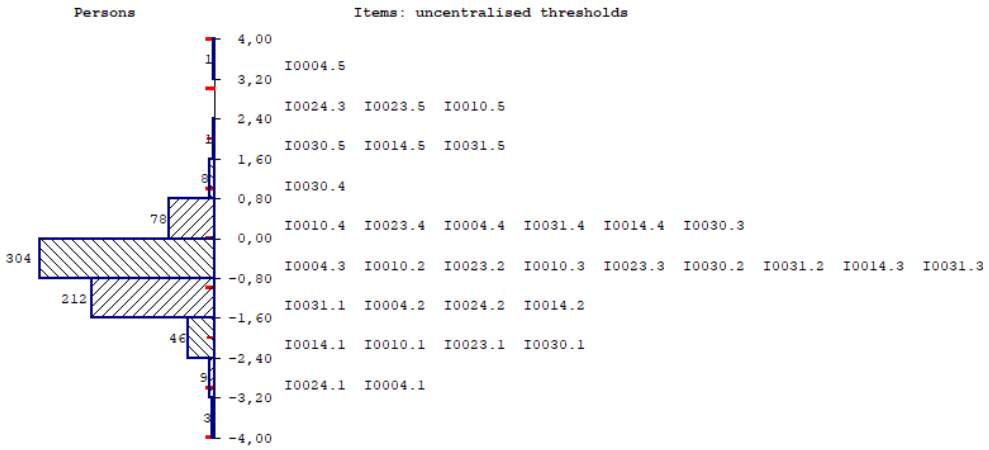

Figure 1. Item map of the 7-items biomedical subscale of the Norwgian version of the PABS. Item threshold locations are displayed on the right. Person locations on the left. Numbers represent item numbers with their threshold between two adjecent response options. The item map provides information about the releative difficulty of (thresholds of) items.

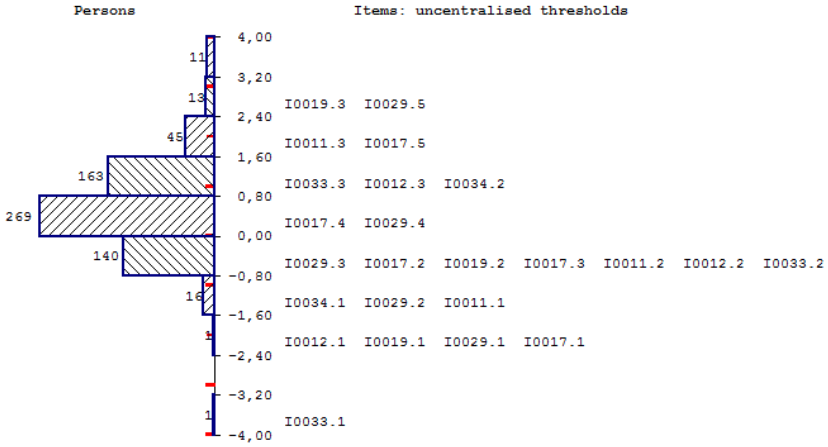

Figure 2. Item map of the 7-items biopsychosocial subscale of the Norwegian PABS.

4.5.3 Paper III. Hypothesis-testing

The validity of a cross-cultural adapted questionnaire should be checked by assessing its construct validity. This may be done by checking whether the translated instrument shows the expected correlations with related constructs and is able to discriminate between relevant subgroups (de Vet et al., 2011, page 184). We explored discriminative ability of the 14-items Rasch modelled Norwegian version of the PABS by performing construct validation by hypothesis-testing. Specific hypotheses about expected differences in PABS scores between known subgroups of physiotherapists were formulated based on evidence from research and theoretical considerations. The basic principle of construct validation is that the direction and magnitude of correlations and/or differences are quantified in advance (preferably before data collection) and formulated in the hypotheses (Mokkink et al., 2010b). Dependent on their consistency with the results of the analysis, hypotheses are either confirmed or not confirmed. Subscales of the PABS-PT were considered to have adequate discriminative validity if at least 75% of the hypotheses are confirmed according to proposed consensus-based criteria (Terwee et al., 2007).

We searched the literature for studies providing information on (conceptual and measured) differences in attitudes and pain beliefs among health care providers. A limited number of studies were found: Eleven studies reported on the back-pain beliefs of physiotherapists and 17 studies compared back pain beliefs of physicians, osteopaths or chiropractors. The qualitative, quantitative and review studies found suitable for our hypotheses are listed in Appendix 6.

Four hypotheses (hypotheses 7 to 10) were formulated on theoretical considerations. A pain-contingent approach is characteristic of a biomedical treatment orientation and differs from a time-contingent approach, characteristic of a biopsychosocial treatment approach (Oostendorp et al., 2017, Ostelo et al., 2003, Houben et al., 2005b, Swinkels et al., 2005). Likewise, a treatment focusing on impairments, like mobility, muscle strength and motor control is more biomedically orientated and less biopsychosocially orientated than a treatment focusing on activities and participation.

The following issues were considered in the process of hypotheses formulating:

(1) Our previous Rasch model analysis of the PABS indicated a limited spread of scores on both subscales and we expected very small mean differences between groups. One scale point (the least possible measure unit) was accepted as an indication for an adequate difference between subgroups. For two hypotheses (hypotheses 7 and 8) a difference of at least 1.5 points was expected. Expected values were arbitrarily chosen, based on comparable findings in the study by Vonk et al.

(2) Hypotheses were formulated as differences in score points, although we also reported p-values and confidence intervals of differences for all between-groups differences. P-values could not be decisive for whether hypotheses are confirmed or not, because they depend on both the sample size and on the (magnitude of) differences between groups. As our sample size was large (n=662), we were concerned that very small differences could become statistically significant.

Next, five subgroups of physiotherapists were constructed based on combinations of biomedical and biopsychosocial scores. These subgroups with so-called "global treatment attitudes" (Vonk et al., 2009) were subjected to further hypothesis-testing The rationale was to increase the contrast between physiotherapists, as our Rasch model analysis had shown that the PABS differentiates better between groups then between individuals. We compared subgroups of physiotherapists with high biomedical scores and low biopsychosocial scores ("purely" or "extreme" biomedical global treatment attitudes) with subgroups with low biomedical and high biopsychosocial scores ("purely" or "extreme" biopsychosocial global treatment attitudes). This was done by categorizing scores on each subscale into four (quartiles) groups called "highest scores", "higher scores", "lower scores" and "lowest scores" and then construct combinations of these. See Tables 5 and 6 for possible combinations. This resulted in five categories, ranging from "purely" biomedical to" purely" biopsychosocial global treatment attitudes. We expected larger score differences between these contrasting subgroups of physiotherapists compared to the other subgroups and adjusted our hypotheses accordingly.

Table 5. Construction of the five global treatment attitudes based on combining four quartiles on the subscales. Cut point calculation.

Biomedical scores	score	Biopsychosocial scores	score
BM1. highest quartile scores		BPS1. Highest quartile scores	
25 % quartile	18.8	25 % quartile	17.7
BM2. Higher quartile scores		BPS2. Higher quartile scores	
median	20.3	median	18.5
BM3. Lower quartile scores		BPS3. Lower quartile scores	
75% quartile	21.7	75 % quartile	20.7
BM4. Lowest quartile scores		BPS4. Lowest quartile scores	

BM1 to BM4: Biomedical subscale quartiles. BPS1 to BPS4: Biopsychosocial subscale quartiles. Physiotherapists with biomedical score exceeding 21.7 points and biopsychosocial scores below 17.7 points are classified as having a purely biomedical global attitude. Physiotherapists with biopsychosocial scores above 20.7 and biomedical scores below 18.8 are classified as having purely biopsychosocial global attitudes.

Table 6. Global treatment attitudes: patterns of combining the quartiles of the biomedical (BM) and the biopsychosocial (BPS) subscales

Global treatment orientation	Combination of quartiles
Purely biomedical global attitude	BM1 + BPS4
More biomedical global attitude	BM1 + BPS3 BM2 + BPS4
Neutral global attitude	BM1 + BPS 1, BM2+BPS2, BM3 + BPS3, BM4 + BPS 4 BM1 + BPS2, BM2 + BPS3, BM3 + BM4 BPS1 + BM2, BPS2 + BM3, BPS3 + BM4
More biopsychosocial global attitude	BM4 + BPS2 BM3 + BPS1
Purely biopsychosocial global attitudes	BM4 + BPS1

BM1 to BM4: Biomedical subscale quartiles from highest to lowest. BPS1 to BPS4: Biopsychosocial subscale quartiles from highest to lowest

4.5.4 Paper IV: Content validity testing

In qualitative analyses, respondents' words and phrases are used as data and analyzed and classified by themes and sub-themes (Patrick et al., 2011a). Analysis in cognitive interviewing aims to transform a series of individual comments into a coherent set of summary findings that transcend the individual interview level (Boeije and Willis, 2013). The analysis may be the most complex part of the qualitative study.

In this thesis, we used a thematic framework method of data management as described by Willis (Willis, 2005, Willis and Artino, 2013) and Pope (Pope et al., 2000) and we followed the same analytic approach as used by Hush (Hush et al., 2010). After transcription of the complete interviews, data were arranged per item per participant across the three steps of the interview. Core quotations and comments were coded and subsequently grouped into cognitive interview summary tables (Patrick et al., 2011b). Summary tables were constructed separately for the comprehensibility and relevance of the items and for the comprehensiveness of the scale as a whole. The summary tables consisted of predefined categories and subcategories and are displayed in Table 7. Next, the content in each category was condensed and illustrative quotations identified. Finally, the condensations were abstracted, presenting a reconceptualized description of the relevance, comprehensibility and the comprehensiveness of the items. The identified categories, labelling and themes were reviewed by a second researcher with careful reference to the source transcripts.

Analysis of qualitative data from cognitive interviews is an iterative process and ideally begins before the interviewing is completed (Beatty and Willis, 2007). We conducted seven interviews and then paused to assess the preliminary results and the quality of the data material before continuing (Boeije and Willis, 2013). In addition, we reviewed the interview guide after each interview and modified the questions if necessary.

Table 7. Categories in the cognitive interview summary tables

Category	Sub-category
I. Relevance and comprehensibility of the items	
	• Subject spontaneous response (think-aloud) • Subject responses to inquiry about what the item means (interpretation) • Subject responses to inquiry about content/wording of the item (comprehensibility) • Subject responses to inquiry about the intent of the item, if the item makes sense (relevance) • Suggestion for changes to item (action to take)
II. Usability and applicability	
	• Subject spontaneous response on responding the scale • Subject responses to inquiry about how it was to answer the questionnaire • Subject responses to inquiry about the introduction and instructions • Subject responses to inquiry about the response categories • Comments and discussion • Suggestion for changes to item (action to take)
III. Comprehensiveness	
	• Subject responses to inquiry about the comprehensiveness of the scale • Does the instrument capture what is important to you? • What is not captured by these instruments that is important to you • Subject response to inquiry on missing content • Comments and discussion • Suggestion for changes to item (action to take)
IV. Conceptual issues	
	• Subject responses to inquiry about what the scale represents (the construct) • Subject response to inquiry what should be asked to grasp the participant's treatment orientation • Subject response to inquiry about his/her treatment philosophy • Comments and discussion • Suggestion for changes to item (action to take)

4.6 Ethical considerations

In electronic surveys, ethical considerations mainly concern issues like informed consent, information to responders, and mechanisms used to protect unauthorized access to personal information (Eysenbach, 2004). In qualitative research, ethical issues such as possible benefits and costs to participants are relevant and should be considered, for example with respect to appropriate levels of monetary compensation (Boeije and Willis, 2013).

The project plans for the survey in Paper I and the cognitive study in Paper IV were reviewed and approved by the Norwegian Centre for Research Data before study start. The survey data for Paper I were handled by SurveyMonkey. All communication with their database was encrypted. Log files contained no personal identification items, e-mail addresses or IP addresses. Entrance and exit by the respondents were time stamped. No incentives were offered to the responders for completing the questionnaire. In the cognitive interview study of Paper IV, thorough information was given in writing and verbally on the purpose and the procedure. All participating physiotherapists were given a small gift. When asked at the end of the interview, all participants reported to have enjoyed being interviewed and given the opportunity to express their thoughts, opinions and feelings about their treatment approach in LBP management.

5. Review of the four papers

Paper 1. The Pain Attitudes and Beliefs Scale for Physiotherapists: Dimensionality and Internal Consistency of the Norwegian Version

Nicolaas D. Eland, Alice Kvåle, Raymond W.J.G Ostelo, Liv Inger Strand

BACKGROUND AND AIM: In Norway, no instrument was available to measure clinicians' (mal)adaptive back pain beliefs. The aim was therefore to translate the PABS-PT into Norwegian from the original 36-item Dutch version and to examine its dimensionality and internal consistency.

METHODS. The Norwegian version was generated in a forward–backward translation procedure. To examine construct validity, a cross-sectional web-based survey was conducted. A convenience sample of 3849 physiotherapists was invited to fill out the Norwegian PABS-PT, together with demographic and professional data. Only therapists who had treated at least one patient with low back pain (LBP) for the last 6 months were included. Principal axis factor and Cronbach's alpha analyses were performed to determine the factor structure and internal consistency, respectively.

RESULTS. The PABS-PT was successfully translated into Norwegian. Survey responses from 921 therapists were obtained (response rate 24.8%), and of these, 647 could be included in the factor analysis. Analysis revealed two factors, labelled 'biomedical'(factor I) and biopsychosocial' treatment orientation (factor II), which confirmed the structure of the original Dutch version. Thirty-six items were reduced to 19, with 13 items loading on factor I and six items loading on factor II, explaining 18.1% and 7.1%, respectively, of the total variance. Cronbach's alpha of the biomedical sub-scale was 0.79 and of the bio-psychosocial sub-scale 0.57.

CONCLUSION. The Norwegian version of the PABS-PT appears to be equivalent to the original Dutch version, showing a similar structural validity and internal

consistency. However, the two factors accounted for low explained variance, which may be indicative for problematic construct validity.

Paper 2. Rasch analysis resulted in an improved Norwegian version of the Pain Attitudes and Beliefs Scale (PABS)

Nicolaas D. Eland, Alice Kvåle, Raymond W.J.G Ostelo, Liv Inger Strand

BACKGROUND AND AIM: The PABS' internal construct validity has been a concern because of low internal consistency and low explained variance. The aim of this study was to examine and improve the scale's measurement properties and item performance using modern test theory.

METHODS: A convenience sample of 667 Norwegian physiotherapists provided data for Rasch model analysis. The biomedical and biopsychosocial subscales of the PABS were examined for unidimensionality, local response dependency, invariance in response category function and the targeting of persons and items. Reliability was measured with the person separation index (PSI). Items originally excluded by the developers of the scale because of skewness were re-introduced in a second analysis.

RESULTS: Our analysis suggested that both subscales required removal of several psychometrically redundant and misfitting items to satisfy the requirements of the Rasch measurement model. Most biopsychosocial items needed revision of their scoring structure. Furthermore, we identified two items originally excluded because of skewness that improved the reliability of the subscales after re-introduction. The ultimate result was two strictly unidimensional subscales, each consisting of seven items, exhibiting a consistent and invariant hierarchy of difficulty and free from any form of misfit. The unidimensionality implies that summation of items to valid total scores is justified. Transformation tables were provided to convert raw ordinal scores to unbiased interval-level scores (Appendix 2). Both subscales were adequately targeted at the ability level of our physiotherapist population. Reliability of the biomedical subscale as measured with the PSI was 0.69. A low PSI of 0.64 for the

biopsychosocial subscale indicated limitations with regard to its discriminative ability.

CONCLUSIONS: The Rasch model analysis produced an improved Norwegian version of the PABS which represents true (fundamental) measurement of clinicians' biomedical and biopsychosocial treatment orientation. However, researchers should be aware of the low discriminative ability of the biopsychosocial subscale when analyzing differences and effect changes.

IMPLICATIONS: The study presents a revised PABS with an interval-level scale providing greater accuracy than ordinal scores in measuring clinicians' pain beliefs.

Paper 3. Discriminative Validity of the Pain Attitudes and Beliefs Scale for Physical Therapists

Nicolaas D. Eland, Alice Kvåle, Raymond W.J.G. Ostelo, Henrica C. W. de Vet, Liv Inger Strand

BACKGROUND AND AIM: Rasch model analysis indicate uncertainty concerning the discriminative ability of the PABS. The aim of this study was to assess whether the Rasch-modified Norwegian version of the PABS can differentiate between subgroups of physical therapists hypothesized to differ in treatment orientations.

METHODS: This was a cross-sectional survey. The PABS was completed by 662 Norwegian physical therapists with a diversity of professional backgrounds. Twenty-four a priori hypotheses on expected differences in PABS scores between subgroups of physiotherapists were formulated. Sufficient discriminative ability was defined as a minimum of 75% confirmed hypotheses. Hypotheses on differences in scores were tested for the biomedical and biopsychosocial subscales separately as well as for combinations of the two subscales, representing responders with high biomedical and low biopsychosocial PABS scores and vice versa.

RESULTS: Of the 24 hypotheses, only 15 (62.5%) were confirmed. Between-group differences concerning the separate subscales were small, varying from -0.63 to 1.70 scale points, representing values up to 6.0% of the total subscale ranges. Between-group differences were larger when combined subscales were used, varying from 1.80 to 6.70 points, representing values up to 25.1% of the total subscale ranges. Despite little spread in scores, 24% of the respondents demonstrated extreme attitudes.

LIMITATIONS: The lack of convincing scientific evidence from previous research on differences in attitudes and beliefs between physical therapists was a limitation for the formulation of hypotheses.

CONCLUSIONS: Discriminative validity of the separate subscales of the PABS was not supported. Combining the two subscales into global treatment attitudes enabled better discrimination. Little spread in biomedical and biopsychosocial orientations explains why more than one-third of the hypotheses were not confirmed. Either Norwegian physical therapists are basically similar in their treatment orientation or social desirability makes it difficult for them to disagree with the widely accepted biopsychosocial model. A further option is that the PABS is not able to detect any differences between them.

Paper 4. How do physiotherapists understand and interpret the "Pain Attitudes and Beliefs Scale"? A cognitive interview study.

Nicolaas D. Eland, Liv Inger Strand, Raymond W.J.G Ostelo, Alice Kvåle, Liv H. Magnussen

BACKGROUND AND AIM: Content validity is considered the most important psychometric property of a measurement instrument, affecting other measurement properties. It is still unknown whether the PABS has adequate content validity. The aim of this study was to explore content validity of the Norwegian PABS by

examining its relevance, comprehensibility and comprehensiveness, following international guidelines.

METHODS: Cognitive individual interviews were performed using the Three-Step Test Interview method, consisting of think-aloud techniques, retrospective probing and in-depth interviews. Eleven Norwegian physiotherapists with a diversity of professional backgrounds participated.

RESULTS: The participants encountered little difficulty in completing the PABS. All items were deemed relevant and important, but five items were considered to have had ambiguous formulations which can easily be handled. The biomedical subscale appeared to be a comprehensive representation of biomedical treatment orientation. The biopsychosocial subscale was found to lack items reflecting important cognitive behavioral aspects of LBP management, such as patient education, therapeutic alliance, shared decision-making and graded exposure.

CONCLUSIONS: This study provides empirical evidence that the Norwegian version of the PABS-PT is relevant and comprehensible, provided some minor adjustments. The biopsychosocial subscale, however, lacks comprehensiveness, as it is not able to capture important aspects of contemporary biopsychosocial best practice care. Measurement of biopsychosocial treatment orientation may therefore be incomplete.

6. Summary of main results

The Norwegian translation of the PABS-PT appears to be semantically and idiomatically rather equivalent to the original 36 items Dutch version. Factor analysis revealed two factors, which were found to represent a biomedical and a biopsychosocial treatment orientation, respectively. Thirteen of the 36 items loaded on (biomedical) factor I, whereas six items loaded on (biopsychosocial) factor II. Accordingly, the number of items loading on the two factors differed from the Dutch version (which has 10 biomedical and 9 biopsychosocial items). The two factors accounted for very low explained variance, (18.1% and 7.1%, respectively). Internal consistency, represented by Cronbach's alpha, was good for the biomedical factor (alpha = 0.79), but low (alpha = 0.57) for the bio-psychosocial factor (Paper I). The low explained variance in both factors raises questions regarding the internal construct validity of the PABS

Modern Measurement Theory is an adequate method to examine the internal construct validity of a measurement instrument. Rasch model analysis of both the 19 items Dutch version (10 biomedical and 9 biopsychosocial items) and the preliminary Norwegian version (13 biomedical and 6 biopsychosocial items) revealed that neither version fitted the Rasch measurement model. Some items in these versions were found to exhibit differential items functioning (DIF) and local response dependency. Most biopsychosocial items showed disordered response categories. Attempts to refine the Dutch and preliminary Norwegian version by accounting for these sources of misfit, failed. Instead, we succeeded in finding two sets of items that were free for any form of significant individual or collective misfit, each acting together as unidimensional subscales. This was done by removing and reintroducing items in an iterative process, from the original 36- items PABS-PT. The ultimate result was two strictly unidimensional subscales, each consisting of seven items in an invariant, hierarchical ordering and being free from any form for misfit. Although internal consistency of the biopsychosocial subscale slightly improved in the refinement process when compared to the original Norwegian version, it remained under recommended values. A PSI of 0.64 and a Cronbach's alpha of 0.60 of the modified

biopsychosocial subscale may indicate problems with differentiating between individual clinicians and groups of clinicians (Paper II).

For a closer examination of this suspected shortcoming, we performed a construct validation by hypothesis testing to explore the discriminative validity of the PABS-PT. Of 24 predefined hypotheses on expected differences between PABS scores of groups of physiotherapists with known characteristics and properties, only 15 (62.5%) were confirmed, implying that discriminative validity of the original subscales is not supported. Differences in scores between groups were very small, less than 1.7 scale points, representing values up to 6% of the theoretical subscale range. However, when constructing subgroups with high scores on one subscale and low scores on the other, differences between subgroups became larger (from 1.8 to 6.7 scale points), representing up to 25.1% of the scale range (Paper III).

In a serial of 11 individual cognitive interviews, physiotherapists reported some minor issues regarding the relevance, comprehensibility and comprehensiveness of the items of the PABS-PT. Issues concerned ambiguous or difficult formulation of five items, which can easily be handled. However, the biopsychosocial subscale was reported to lack items on important principles of cognitive behavioral LBP management, such as patient involvement, therapeutic alliance, shared decision making, graded exposure and patient (pain) education. The participants considered these aspects of great importance for biopsychosocial best practice care (Paper IV).

7. Discussion

7.1 Discussion of main findings in the thesis

The aim of this thesis was to develop a Norwegian version of the Pain Attitudes and Beliefs Scale (PABS). After translation and cultural adaptation, the PABS was tested for its structural validity, internal construct validity, discriminative validity and content validity. The validation process succeeded in improving the scale's performance to a certain degree, resulting in two strictly unidimensional subscales, each consisting of seven items. However, important psychometric shortcomings were revealed. The main finding was that the Norwegian PABS does not adequately distinguish higher levels from lower levels of biomedical or biopsychosocial treatment orientation. Another key finding was that the biopsychosocial subscale does not capture important aspects of contemporary biopsychosocial treatment orientation. The main findings are discussed below.

The translation and adaptation procedure were uncomplicated and produced a Norwegian version that we believe is satisfactory equivalent to the original Dutch PABS-PT. Differences in wording and meaning between the Dutch and the English version were settled by consensus. A problematic discriminative ability of the PABS subscales appeared to be a recurrent issue in all four papers. Discrimination can be described as "the degree to which items are able to distinguish the proficiencies of the persons" (Andrich and Marais, 2019, page 35). Proper discriminative ability should be an important property for the PABS, as the instrument was originally designed to differentiate between clinicians with biomedical and biopsychosocial treatment orientations. Furthermore, discrimination is a premise for good responsiveness (Streiner et al., 2014). Low discriminative ability was suspected in studies I and II. In study I, we found homogeneity of responses with low variation and a general trend toward higher levels of agreement in the biopsychosocial subscale and higher levels of disagreement in the biomedical subscale. Furthermore, we found items with low

item-total correlations. The item-total correlation is known as a kind of discrimination parameter, because those persons who obtain a high score on the item, should also tend to obtain a high score on the test (assumed that the item is part of an unidimensional scale) (de Vet et al., 2011). Likewise, those persons who obtain a low score on the item should tend to obtain a low total score on the test (Andrich and Marais, 2019, page 34). De Vet et al. state that items with an item-total correlation of less than 0.3 may not contribute much to the discrimination of individuals on the construct under study (de Vet et al., 2011), whereas Streiner et al. suggest to delete items with an item-total correlation below 0.2 (Streiner et al., 2014). We decided to follow Streiner et al. and included four items with low discrimination (correlations below 0.3 but above 0.2) in our item pool. Conversely, in Paper II, using Rasch modelling, we removed four items, because of excessive underdiscrimination. In spite of this, our refinement attempts hardly improved the power of the construct to discriminate among the respondent, as the PSI values did not reach the required level, 0.70. This means that it was still uncertain whether two groups of persons could be differentiated statistically (Tennant and Conaghan, 2007). In paper III, we specifically examined the discriminative ability, and found that several hypotheses concerning the scale's ability to differentiate between groups of physiotherapists were not confirmed. Furthermore, findings in Study IV confirmed low discrimination as the interviewed physiotherapists generally agreed on biopsychosocial items and disagreed on biomedical items, and neither agreed or disagreed on items that they found unclearly defined or had no strong feelings about.

The homogeneity of responses found by us in Studies I, II and III has been confirmed in several other studies (Duncan, 2017, Vonk et al., 2009, Young et al., 2019a). High levels of agreement or poor spread of responses are known to negatively influence reliability and discrimination parameters like ICC and Cronbach's alpha and the PSI (de Vet et al., 2011, Kreiner and Christensen, 2013). We found a clustering of scores toward the upper end of the biopsychosocial subscale, indicating our respondents' support of the biopsychosocial model. A similar, but less pronounced clustering was found toward the lower end of the biomedical subscale. The high agreement levels have been attributed to social desirability, related to the respondents' knowledge of

clinical guidelines (Houben et al., 2005b, Duncan, 2017, Bowey-Morris et al., 2010, Vonk et al., 2009, Jellema et al., 2005).

The second main finding in the thesis is that the biopsychosocial subscale does not capture important aspects of contemporary biopsychosocial best practice care, as shown in Paper IV. This lack of comprehensiveness may be related to the insufficient discriminative ability. Contemporary biopsychosocial care is based on cognitive behavioral principles within patient-centered care and includes concepts like patient involvement, therapeutic alliance, shared decision making and graded exposure. However, the items of the biopsychosocial subscale seem to only represent an acceptance of continued normal activity despite pain and the impact of psychosocial factors on LBP. All participants in Study IV supported that the items reflected a biopsychosocial model of care but indicated nevertheless that items were missing to capture other important aspects of their treatment approach. In clinical practice, they have a variety of treatment approaches, depending on the context of the therapeutic meeting and the patient's complaints. Whether the back complaints were acute or chronic, was one example of what could be decisive for their choice of treatment. The participants seemed to have a more practical approach, related to daily patient management and could expressed this in the interviews by saying "it depends".

7.2 Comparison with recent studies

Two other studies have examined the psychometric properties of the PABS or have made attempts to improve it since the publication of Paper I. A recent study used item response theory (IRT) to examine the English version of PABS and concluded that the 10-item biomedical scale displayed adequate psychometric performance (Chiarotto et al., 2018a). Suggestions were made that the scale could be used to assess professionals' degree of biomedical orientation on a group level. The researchers did not examine the biopsychosocial subscale with IRT because of sparseness of response options, without specifying what was meant by that.

Duncan (2017) also examined the English version of the biomedical subscale and developed a new biopsychosocial subscale for use in generic musculoskeletal pain (Duncan, 2017). A scoping review revealed that the original biopsychosocial subscale had a narrow conceptual range, therefor new items were collected using concept mapping. Both exploratory and confirmatory factor analysis confirmed the original biomedical and the new biopsychosocial subscales' unidimensionality with good internal consistency and good test-retest reliability. However, the new biopsychosocial subscale was found to perform poorly at item level. Scores were clustering in the upper end of the scale and levels of agreement were very high. The author therefore expected poor discriminative ability and poor responsiveness of this new subscale (Duncan, 2017).

In conclusion, recent psychometric examination using item response theory concluded that the original 10 items of the English biomedical subscale make a unidimensional construct. They did not consider low discrimination of three items to be a reason for removing these items (Chiarotto et al., 2018a). Compared to our Study II, differences in findings may be explained by different analytic methods i.e. the one-parameter Rasch model versus the two-parameter IRT model. Furthermore, compared to our Papers II and III, very similar problems were met concerning low discriminative ability and high levels of agreement in attempts to improve the English biopsychosocial subscale (Duncan, 2017).

7.3 The current state of the PABS, its use and future

The PABS has been used and is still used in a range of cross-sectional studies measuring treatment orientation among physiotherapists, physicians, chiropractors and osteopaths (Young et al., 2019b, Macdonald et al., 2018, Lady et al., 2018, Sit et al., 2015). However, at present, the scale has frequently been used in test-retest studies to evaluate the effect of biopsychosocial educational programs on clinicians' attitudes and beliefs, treatment behaviors and if possible, patient outcome (Kongsted

et al., 2019). The 19-items Houben PABS version has been used most frequently for this purpose, although the 14-items Rasch modified version has been considered a promising alternative (Kongsted et al., 2019).

Although the Rasch modified PABS subscales have shorter score range, they offer more precise interval-level measurement of respondents' proficiencies, compared to ordinal-level sum scores. Interval level scores are especially of advantage when score changes, their confidence interval and their statistical significance are to be measured. More precise measurement may also be expected for the Rasch-modified biopsychosocial subscale, despite an even shorter total scale range (7 to 32 points).

Although the PABS has been used in a range of test-retest studies (see Appendix 5), little is known about its performance and responsiveness in such studies. However, as the discriminative ability of the PABS has been found to be poor, responsiveness has been expected to be poor too (Duncan et al., 2018). In the studies evaluating the impact of biopsychosocial education (Jellema et al., 2005, Overmeer et al., 2011, Domenech et al., 2011, Jacobs et al., 2016, Vonk et al., 2009, Beneciuk and George, 2015, Bowey-Morris et al., 2010, Overmeer et al., 2009, Demmelmaier et al., 2012, Rebbeck et al., 2013, O'Keeffe et al., 2015, Beneciuk et al., 2019, Richmond et al., 2016, Cox et al., 2017, Wang et al., 2018, Dwyer et al., 2019, Montesinos et al., 2019), the biomedical subscale performed best and was able to measure significant score changes ranging from 3.0 to 9.9 points (median 6.1). The biopsychosocial subscale did not perform as well and score changes were generally very small, ranging from 0 to 5.5 points (median 2.33). Three studies reported effect sizes, which were large for the biomedical subscale (range from d=0.92 to 1.62) and smaller for the biopsychosocial subscale (range: d= 0.19 to 0.86). Two studies reported results of both the PABS and the HC-PAIRS (Beneciuk and George, 2015, Montesinos et al., 2019). Compared to the PABS, change scores on the HC-PAIRS were non-significant and had small effect sizes.

As the biomedical subscale performs considerably better than the biopsychosocial subscale, it may be tempting to only use the biomedical subscale in test-retest studies

(Chiarotto et al., 2018a). However, excluding the biopsychosocial subscale has a clear disadvantage as using both subscales may help validate the responses of the respondents. When scores are very high on both subscales, an exceptional response is given that requires further action, either by a qualitative interview of the person in question to find the reason for responding that way, or by removing this person from the dataset as an outlier. The same applies for very low scores on both subscales.

In Study IV, we identified ambiguous wording in some items and proposed slight adjustments. However, it is not known whether the PABS performs better with these modifications as responses may possibly become more homogeneous when items are understood more alike, complicating discriminative ability even more. Making more extensive changes to items in the present version of PABS should be done with care, as this may have important consequences for the comparability and standardization of PABS scores. Changing the wording of a question could change its meaning and therefore the interpretation of the total score (Paap et al., 2016).

In study IV, we proposed to supplement the PABS with questionnaires that represent different, but related constructs like patient-centeredness, confidence in treating patients with back pain, clinician empathy or the patient-therapist working alliance. We argued that such supplement may give a broader insight into clinicians' attitudes and beliefs. During the last few years several studies have combined the PABS with other questionnaires (Beneciuk et al., 2019, Kongsted et al., 2019, Bareiss et al., 2019, Wang et al., 2018, Demmelmaier et al., 2012). In the most recent study, Beneciuk et al. concluded that the PABS-PT combined with instruments measuring clinician confidence provided one viable option for assessment of the impact of psychologically informed physiotherapy training on clinician attitudes and beliefs (Beneciuk et al., 2019).

Finally, in Paper III, we constructed categories of physiotherapists with high biomedical and low biopsychosocial orientations (and vice versa) called "global treatment attitudes" (Vonk et al., 2009). This categorization into extreme groups has

successfully been used in cross-sectional studies to predict treatment behavior, such as advising continued work absence (Bishop et al., 2008, Vonk et al., 2009).

Summarized, the Rasch modified version of the PABS is expected to perform more precise when evaluating score changes in test-retest studies. Furthermore, the biopsychosocial subscale should be included despite its poor discriminative ability. Further development with new items has proven difficult. Broader insight in clinicians' attitudes and beliefs may be obtained by supplementing the PABS with other, related questionnaires.

7.4 Exploring the term of biopsychosocial approach in physiotherapy

Although the biopsychosocial model is widely accepted, limited knowledge exists on how the model is understood by physiotherapists. A recent interview study found that physiotherapists clearly appreciate the multi-dimensional nature of non-specific LBP but found it difficult to treat patients with cognitive and emotional pain drivers. Furthermore, they perceived that a broad biopsychosocial approach was common practice in physiotherapy (Cowell et al., 2018). This contradiction underlines the need for a clear definition of what a biopsychosocial approach entails (Cheng et al., 2016). A clear definition of the construct may help explain why the participants in Paper IV agreed on all biopsychosocial items and why they considered the PABS to miss important aspect of best practice care.

A biopsychosocial approach is considered best practice care for chronic LBP in physiotherapy (Foster and Delitto, 2011). However, simply being aware of the importance of psychosocial factors does not necessarily translate into a biopsychosocial practice approach (Dwyer et al., 2019). A (multidisciplinary) biopsychosocial approach has been defined as:

> "A multicomponent intervention including at least (1) a biological component (e.g. to improve (knowledge of) physical components, pain physiology, pain sensitization, or differences between acute and chronic pain) and (2) a psychological or social component (e.g. to improve knowledge about the influence of cognitions, attitude, (pain) behavior, coping styles, self-management strategies, and/or coping styles of family, friends, and colleagues" (van Erp et al., 2019, Kamper et al., 2015).

The definition of a biopsychosocial approach seems, accordingly, to focus on knowledge aspects of biological, psychological and social dimensions of illness.

Under the broad umbrella of the biopsychosocial approach to understanding chronic pain, several more specific physiotherapy models have been developed. These models include patient-centered physiotherapy (Cheng et al., 2016), psychologically informed physiotherapy (PIP) (Main and George, 2011), cognitive functional therapy (CFT) (O'Sullivan et al., 2018) and pain neuroscience education (PNE) (Wijma et al., 2016).

In the definition, the biopsychosocial approach is conceived as a way of understanding the patient's illnesses. However, as Mead et al. pointed out, a biopsychosocial perspective alone is not sufficient for a full understanding of the patient's experience of illness (Mead and Bower, 2000). Patient-centered physiotherapy is considered to be the practical application of the multidimensional biopsychosocial model of illness (Langendoen, 2004, Sanders et al., 2013, Foster and Delitto, 2011). Two key dimensions of patient-centered physiotherapy are the understanding of the patients' illnesses from a biopsychosocial perspective and the development of a strong therapeutic alliance (Cowell et al., 2019, Mead and Bower, 2000). Patient-centered physiotherapy has been defined as:

> "Care that responds to the individual context of the patient, employs effective communication and uses shared decision-making processes" (Lin et al., 2020).

Another approach, psychologically informed physiotherapy (PIP) aims to enhance secondary prevention of disability and better outcomes at reduced costs (Main and George, 2011). The most important goal of the interview is to establish an effective therapeutic alliance (Keefe et al., 2018). Psychologically informed physical therapy (PIPT) has been defined as:

> ”A secondary biopsychosocial prevention approach for LBP that first aims to identify individuals at high risk for transitioning to chronicity and then provides tailored treatment by merging impairment-focused physical therapy with cognitive behavioral therapy methods as needed to reduce that risk” (Main and George, 2011, Beneciuk et al., 2019, Beneciuk and George, 2015, Young et al., 2019a).

In two other physiotherapy methods, cognitive functional therapy (CFT) and pain neuroscience education (PNE), a strong therapeutic alliance is also central (Cowell et al., 2018, Wijma et al., 2018). Unique for CFT is the use of cognitive behavioral experiments in exposure sessions to modify pain-related functional behaviors (Cowell et al., 2019), whereas pain neuroscience education (PNE) explains the mechanisms of central sensitization to the patient from a biopsychosocial view on chronic pain.

The biopsychosocial subscale of the PABS addresses three aspects of a biopsychosocial approach: (1) the acceptance of continued normal activity despite pain, (2) the need to address fear-avoidance and (3) the importance of psychosocial factors in illness. Considering that all biopsychosocial orientated methods in physiotherapy ascribe a central role to patient-centeredness and a strong therapeutic alliance in chronic LBP management, it is more understandable why the participants in Study IV commented on the lack of comprehensiveness of the PABS.

7.5 Methodological considerations

7.5.1 Design

Both quantitative and qualitative designs were used in the thesis. The questionnaire's translation and cultural adaptation procedure performed by the expert panel in Paper I, can be regarded as qualitative research. The quantitative data for Papers I, II and III were collected in a cross-sectional Internet-based survey. The qualitative data for Paper IV were collected with individual cognitive interviews of physiotherapists using the Three-Step Test-Interview (TSTI) method. This qualitative approach complemented the findings of the three preceding quantitative studies.

7.5.2 Sample

The quantitative analyses in Papers I, II and III, were based on the same survey data material. However, the numbers of included respondents differ between the three studies. The factor analysis in Paper I included 647 respondents, whereas our Rasch model analysis included 667 respondents (Paper II), of which 662 provided valid Rasch scores for the hypothesis testing in Paper III. Differences in numbers of respondents can be explained by exclusion of participants with more than 10% missing responses in factor analysis, the same procedure as Houben at al. (2005) used in their study. In the following Rasch model analysis, considerably more responses could be included because the software RUMM2030 is able to mathematically handle missing responses.

A filter question was used in our survey resulting in exclusion of 147 of 921 respondents who had not treated at least one patient with LBP for the last 6 months. This was in line with the procedure of other studies collecting PABS scores from clinicians (Bishop et al., 2008, Magalhaes et al., 2011). However, we may have missed important information from certain subgroups by excluding these physiotherapists from analysis. For example, the pain beliefs of academic lecturers involved in physiotherapy education seem important, because they may influence the next generation of physiotherapists.

7.5.3 Assessment of content validity

Paper IV in the thesis highlighted the importance and necessity of assessing content validity of the PABS. At the time the PABS was designed, around the year 2000, there was a lack of consensus on taxonomy, terminology, and definitions within psychometrics. Furthermore, there was confusion about the relevance of certain measurement properties and concepts (Mokkink et al., 2010c). Since then, terminology has been clarified and standardized. Guidelines have been developed to assess measurement properties and methodological quality of studies assessing these properties (Mokkink et al., 2010a, Mokkink et al., 2010b). However, only recently the value of qualitative evaluation of content validity has been fully recognized. In 2016, the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) initiative recommended a predefined order of importance for evaluating the measurement properties of an instrument. Firstly, content validity, secondly, internal structure (i.e. structural validity and internal consistency), thirdly, item performance using Item Response Theory or Rasch model fit. Finally, the remaining measurement properties (i.e. reliability, construct validity and responsiveness) can be tested (Prinsen et al., 2016). Guidelines and checklists for evaluation of content validity of measurement instruments were not published until 2018 (Terwee et al., 2018b, Terwee et al., 2018a). Before that time, the importance of qualitative method to assess content validity was generally underestimated.

Content validity is defined as the degree to which the content of an instrument is an adequate reflection of the construct and considered the most important measurement property (Mokkink et al., 2010c). If it is not clear what the instrument is measuring, the assessment of the other measurement properties is less valuable (Terwee et al., 2018b). In other words, insufficient content validity may have negative consequences for other measurement properties. For example, real changes in biopsychosocial treatment orientation can be under- or underestimated because of the subscale's lack of comprehensiveness, without even affecting reliability (Terwee et al., 2018b).

According to guidelines, content validity studies should include the assessment of relevance, comprehensibility and comprehensiveness of the items (Terwee et al., 2018a). However, until recently, the least attention has been paid to the relevance of items and the comprehensiveness of the instrument, whereas comprehensibility has been addressed using a variety of methods (Terwee et al., 2018b).

A recent review confirmed that content validity of most patient-reported outcome measures for patients with LBP is insufficient (Chiarotto et al., 2018b). Previously, the assessment of content validity has received little attention and methods have varied widely. Therefore, it has been suggested that a full qualitative study of content validity should be an integral part of the development of questionnaires (Pool et al., 2010). However, in our cross-cultural adaptation process in Paper I, an extensive qualitative examination of the items was not performed and was not considered necessary at that time. The final step in our translation procedure was, however, a pre-test survey of 25 physiotherapy researchers, to test the lay-out of the questionnaire, the data collection method by SurveyMonkey and the suitability of the collected data material for analysis in SPSS. Similar pre-tests were performed by other studies examining the Dutch, German and Turkish versions of the PABS (Ostelo et al., 2003, Laekeman et al., 2008, Dalkilinc et al., 2015).

Published guidelines for translation and cross-cultural adaptation of questionnaires recommend cognitive debriefing or pre-test surveys in their pilot test phase, intended to check interpretation, cultural relevance of the translation, and ease of comprehension (Beaton et al., 2000, Wild et al., 2005). Neither of the two known guidelines specifically recommends the examination of the relevance and comprehensiveness of items. As measurement equivalence of the translated questionnaire as compared to the original version is considered an important aim of cross-cultural adaptation, assessment of relevance and comprehensiveness may not be prioritized when this is expected been done during development in the original language. Nevertheless, our cross-cultural translation of the PABS might have benefited from cognitive interviews of 6 to 8 persons before the survey, to clarify comprehensibility of the translated items, even when almost half of the 36 PABS

items were deleted after factor analysis and the scale was still in a developmental stage. Two rounds of interviews might have been necessary to retest items if substantial adjustments had been made (Grarup et al., 2018). Nevertheless, it is not certain whether such cognitive debriefing in Paper I would have made our examination of content validity in Paper IV unnecessary. The intention of Study IV was to find out why the subscales showed poor discriminative ability, low alpha values and low separation indexes in Papers I, II and III, despite our attempts to improve their performance. Conducting Paper IV was necessary to show that this may be explained by lack of comprehensiveness and clustering of scores, rather than ambiguities and misunderstandings.

In conclusion, in the thesis we demonstrate that qualitative assessment of content validity can highlight problems that cannot be identified using quantitative methods, both in the developmental phase of a new self-report questionnaire and when examining existing ones.

7.5.4 Classical test theory versus Rasch measurement theory

Questionnaires are expected to precisely measure (unobservable) traits and changes in traits and to be stable across important clinical characteristics of patients, such as age and gender (Kent et al., 2015). Classical test theory (CTT) has been and still is the dominant measurement theory. However, modern test theory represents a logical progression from CTT, as it uses more sophisticated models and techniques (Andrich and Marais, 2019, Petrillo et al., 2015). Within modern test theory, there are two major theories, the two-parametric logistic Item Response Theory (IRT) and the one-parametric logistic Rasch Measurement Theory (RMT). Differences between the two are small. IRT uses mathematical models to describe the empirical data, whereas RMT attempts to fit the empirical data into a mathematical (Rasch) model that satisfies the stricter requirements of scientific measurement (Kean et al., 2018). One might say that IRT is more descriptive, whereas RMT is more prescriptive. In this thesis, we used CTT as well as RMT to examine and improve the PABS. CTT and

RMT are not in contrast to each other but may rather supplement each other (Andrich and Marais, 2019). De Vet et al. argued that scores obtained from CTT and RMT do not diverge as much as one would expect and that correlations between CTT-based and RMT-based scores usually are above 0.95 (de Vet et al., 2011, page 89). However, we performed a post-hoc analysis in Paper III and found important differences in results and conclusions depending on whether scores were derived from CTT or RMT (Figures 3 and 4). Some analytic features of RMT cannot be obtained with CTT analysis, such as item parameters and person ability parameters that can be calibrated on the same linear scale representing the measured latent trait. Furthermore, the optimal number of response options in each item can easily be examined with RMT, which is not possible in CTT.

Direct comparison between CTT and RMT is difficult because they are different methodologies, producing different information and evaluates its own unique set of psychometric properties (Hambleton and Jones, 1993). However, some theoretical principles and their consequences are outlined below.

An important difference between CTT and RMT is that CTT takes the score of a person on an instrument as simply the sum of the person's scores on the items (Andrich and Marais, 2019). In contrast, RMT is concerned with measuring person ability directly by an ordered hierarchy of difficulty of items. In other words, CTT mainly focuses on the performance of the scale, whereas RMT focuses on the performance of items and the pattern of items scores. Furthermore, the universal assumption in CTT that equal distances between response options represent equal distances on the measured dimension is essentially erroneous (Pesudovs and Noble, 2005). The sum scores in CTT are unequally precise measures for persons of different ability (Andrich and Marais, 2019) (Figures 3 and 4, Appendix 2). The uneven distances between scores may have consequences for the PABS when changes are measured in treatment orientation after a biopsychosocial educational intervention. A certain change in sum scores in CCT may not be equivalent to the real change in treatment orientation, being highly dependent on the baseline scores. Subtle changes in treatment orientation in the centre of the scale range may go unnoticed if one uses

the sum scores from CTT, whereas larger changes in treatment orientation in the more extreme ends of the construct may not be detected by a change in CTT scores (Andrich and Marais, 2019). Conversely, in RMT, every item is attributed a difficulty parameter, and change in (logit) scores is a change in difficulty. The result is a more accurate measurement, especially when scores are located toward the extremes of the scale spectrum (Belvedere and de Morton, 2010, Grimby et al., 2012).

An advantage of CTT is its ease of use and the less stringent theoretical assumptions, compared to RMT. A further advantage of applying CTT is that considerable smaller sample sizes are required compared to RMT (Petrillo et al., 2015).

An advantage of RMT is that missing items are handled routinely and do not have to be imputed or excluded, as in CTT. In our sample, 20 responders could be included in Rasch model analysis in addition to the 647 respondents in factor analysis, although this probably affected the precision of estimating the ability of the persons in question. The most important advantage of RMT may be the potential use of estimated ability scores in computer adaptive testing (CAT). Once the item-difficulty hierarchy of an instrument or an item bank is established by Rasch modelling, CAT can be used to target items to the person's ability level (Velozo et al., 1999). However, CAT may be less useful for the PABS, as it takes only a short time to complete the 14-items version.

In Paper II we deleted several items on both subscales to obtain unidimensionality and fit to the model. In retrospect, the question arises whether we were too stringent in our Rasch modelling and rather should have accepted some multidimensionality, misfit and local dependency in order to retain more items. In their IRT analysis of the PABS, Chiarotto et al. (2018) concluded that the biomedical "Houben" subscale performed adequate with the original 10 items despite misfit of one item. They considered item removal inappropriate, as this would lead to a discrepancy with the version of the questionnaire used in previous studies. They further argued that refinement may be re-considered when other samples show comparable misfit (Chiarotto et al., 2018a). However, according to Andrich (2019), every item included

in an instrument should add to the precision and validity of that instrument and items that do not contribute to the scale's performance or are redundant, should be removed. This strategy left us with strictly unidimensional subscales without misfit and producing interval-level data. Although both the 19-items Houben version and the 14-items Rasch modified version can be chosen for evaluation purposes, the Norwegian version provides unbiased measurement.

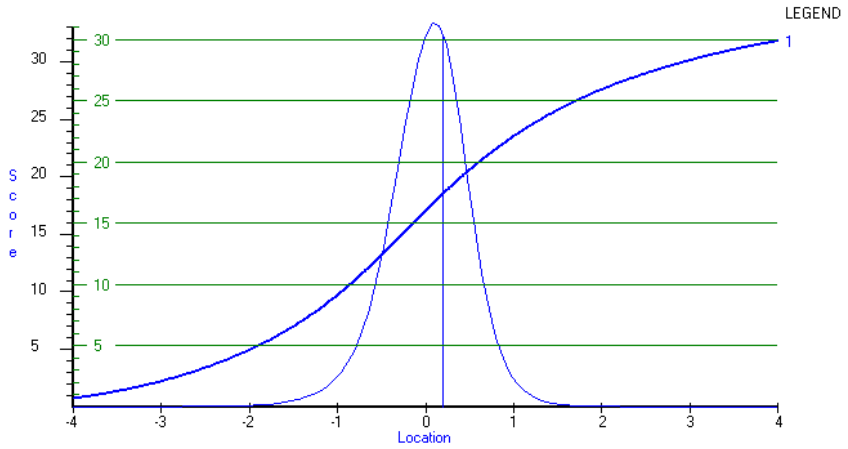

Figure 3. Biomedical subscale. Transformation curve from raw (ordinal) to Logit (interval) scores. Ordinal core range: 0 to 33 scale points. The closed curve represents the information function of the subscale. Little or no information is derived from the upper- and lower ends of the scale. Maximum information for any given item is derived when the person has the same logit ability as the item's logit difficulty. This is at the point where the probability of endorsing an item is 50/50.

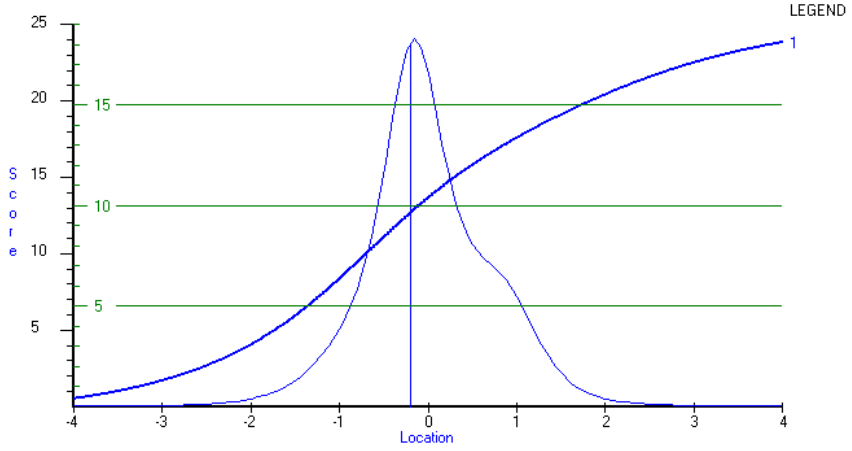

Figure 4. Biopsychosocial subscale. Ordinal score range: 0 to 25 scale points. Transformation curve and information curve.

7.5.5 Cross-cultural validation

An exploratory factor analysis was performed in Paper I, although confirmatory factor analysis is highly recommended for cross-cultural validation purposes (de Vet et al., 2011). An exploratory factor analysis was chosen because the PABS was still considered to be in the development stage (Houben et al., 2005b, Mutsaers et al., 2012). Therefore, the aim of analysis was to explore the dimensionality and item reduction of the 36-item pool. In addition, the structure and performance of the original 10-items Houben version was not known in detail, and a reason to perform an exploratory factor analysis in favor of a confirmatory factor analysis (de Vet et al., 2005). An alternative strategy might have been to perform an exploratory factor analysis first on a randomized subgroup, and thereafter a confirmatory factor analysis on another randomized subgroup of a large number of respondents. Others (Brunner et al., 2017, Duncan, 2017) have used this strategy with advantage. However, we examined the subscales' unidimensionality and item performance instead with Rasch model analysis.

In cross-cultural validation, the equivalence of scores in the original and the new target population has received considerable attention (de Vet et al., 2011). This measurement invariance can be examined with confirmatory factor analysis or with Rasch model analysis/IRT. De Vet et al. (2011) explain the use of confirmatory factor analysis as follows: Items are expected to have retained the same meaning after the translation, when the same factor structure is found in the new population. This means that items should load on the same factors after translation. If they do not, this may indicate that these items have different meanings, either due to the translation or to cultural differences (de Vet et al., 2011, page 185).

In Rasch model analysis, measurement invariance may be assessed by examining differential item functioning (DIF). For that purpose, data from samples from different languages must be combined and compared. If persons from both samples have the same "ability" level of the trait, but do not have the same score on the

original and translated version, the item may measure different concepts in the two samples. For examining DIF, international collaboration is needed to merge the data sets from different languages (Lundgren-Nilsson et al., 2005, McKenna et al., 2013).

In summary: After translation, measurement instruments should be subjected to confirmatory factor analysis when the structure and performance in the original language is known. As this was not known for the PABS, performing exploratory factor analysis was justified when followed by Rasch model analysis to examine item performance. Nevertheless, assessment of the relevance and comprehensiveness of the translated items was necessary.

7.6 Strengths and limitations

A strength of this thesis was the consistent and stringent use of the COSMIN taxonomy, guidelines and checklists in designing and performing the studies in Papers I, II and IV (Terwee et al., 2018b, Mokkink et al., 2010a). International guidelines were also followed when designing the translation study and the survey (Beaton et al., 2000, Dobrow et al., 2008). Another strength was the combined use of classical test theory focusing on scale performance and modern test theory focusing on item performance when examining the PABS's construct validity. A third strength was the large sample size from our survey, providing extensive data for analyses in Papers I, II and III,

A limitation in this thesis may be the inverse order of examining content validity of the PABS. It would have been better to examine the items' relevance, comprehensiveness and comprehensibility at the start of the project as part of the cultural adaptation process in Paper I.

In Paper IV, the sample size of 11 participants for the interview study may have been a limitation for trustworthiness (Wijma et al., 2018). However, we considered information power and participant diversity more critical than the number of

participants, as the sample size in qualitative studies is primarily determined by the study aim and the information that the sample holds (Malterud et al., 2015). As our study aim was narrow, the sample relatively homogeneous regarding participants' profession and the quality of the dialogue was strong, fewer participants were needed (Patrick et al., 2011b).

8. Conclusions and future considerations

The thesis comprises a cross-cultural validation of the Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) into Norwegian. The validation process resulted in an improved Norwegian version with two strictly unidimensional and unbiased subscales. Both subscales can measure group-level physiotherapists' degree of biomedical and biopsychosocial treatment orientation towards non-specific LBP at an interval-level of measurement. However, the PABS has two major shortcomings, affecting its use in clinical research. Firstly, the scale cannot adequately distinguish between physiotherapists with different levels of biomedical and biopsychosocial treatment orientation. Secondly, PABS lacks the ability to measure important aspects of a biopsychosocial treatment approach. These shortcomings have important consequences for future use and further development of the PABS

Users of the PABS should be aware that scores may cluster at the upper or lower end of the scale when respondents widely disagree on biomedical and widely agree on biopsychosocial issues. Furthermore, responsiveness of the PABS will probably be poor. Finally, users should be aware that the biopsychosocial subscale seems to measure the therapists' acceptance of the biopsychosocial model rather than their clinical behavioral approach.

We propose three actions for more confident use of the PABS. Firstly, to use complementary questionnaires measuring related, but different constructs of biopsychosocial care, aiming to provide a broader insight in the attitudes and beliefs of clinicians. Secondly, minor modifications in wording to improve item comprehensibility, as proposed in the thesis. Thirdly, to use the PABS as a measure to identify extreme (biomedical or biopsychosocial) back pain beliefs among clinicians, by combining the two subscales.

As further development of the PABS has proved to be challenging, an alternative for implementation research of best practice care would be to focus on clinicians' treatment behavior. Qualitative studies with observation of practice may prove suitable for this purpose.

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PAPER I

RESEARCH ARTICLE

The Pain Attitudes and Beliefs Scale for Physiotherapists: Dimensionality and Internal Consistency of the Norwegian Version

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Abstract

Background and Purpose. The Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) is a self-administered instrument developed to assess the strength of two possible treatment orientations of physiotherapists towards the management of low back pain. The aim of this study was to translate the PABS-PT into Norwegian from the original 36-item Dutch version and to examine its dimensionality and internal consistency. **Methods.** The Norwegian version was generated in a forward–backward translation procedure. To examine construct validity, a cross-sectional web-based survey was conducted. A convenience sample of 3849 physiotherapists was invited to fill out the Norwegian PABS-PT, together with demographic and professional data. Only therapists who had been involved in back pain management for the last 6 months were included. Principal factor and Cronbach's alpha analyses were performed to determine the factor structure and internal consistency, respectively. **Results.** The PABS-PT was successfully translated into Norwegian. Responses from 921 therapists were obtained (response rate 24.8%), and of these, 647 could be included in the factor analysis. Analysis revealed two factors, labelled 'biomedical' and 'biopsychosocial' treatment orientation, which confirmed the structure of the original Dutch version. Thirty-six items were reduced to 19, with 13 items loading on factor I and six items on factor II, explaining 18.1% and 7.1%, respectively, of the total variance. Cronbach's alpha of the biomedical sub-scale was 0.79 and 0.57 for the bio-psychosocial sub-scale. **Conclusion.** The Norwegian version of the PABS-PT appears to be equivalent to the original Dutch version, showing a similar structure and internal consistency. The two factors accounted for low explained variance, which may be indicative for problematic construct validity. Psychometric properties and usefulness will be further examined.

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Keywords

management and professional issues; pain; physiotherapy; psychometric; questionnaire

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Introduction

Low back pain (LBP) is a major management challenge to health-care providers (Waddell, 2004; Brage *et al.,* 2010). Clinical practice guidelines for LBP emphasize a bio-psychosocial rather than a biomedical approach to care (Bekkering *et al.,* 2003; Lærum *et al.,* 2007), because evidence indicates that disability levels in longstanding LBP are closely associated with cognitive and psychosocial aspects of pain (Linton, 2000; Waddell, 2004). Within the bio-psychosocial model, psychosocial factors are accounted for, acknowledging their potential to amplify pain and drive disability (Main *et al.,* 2008). In spite of evidence that guideline adherence improves outcomes and decreases health-care utilization (Rutten *et al.,* 2010; Lin *et al.,* 2011), persistence of a dominant biomedical approach among physiotherapists has been shown in several studies (Daykin and Richardson, 2004; Swinkels *et al.,* 2005; Pincus *et al.,* 2006; Pincus *et al.,* 2007; Oostendorp *et al.,* 2015).

Health-care providers have been shown to hold a range of cognitions about LBP and disability, and these attitudes and beliefs are found to be associated with certain clinical decisions and treatment behaviours (Rainville *et al.,* 1995; Linton *et al.,* 2002; Ostelo *et al.,* 2003; Houben *et al.,* 2005a; Houben *et al.,* 2005b; Bishop *et al.,* 2008; Ostelo and Vlaeyen, 2008; Evans *et al.,* 2010; Domenech *et al.,* 2011; Darlow *et al.,* 2012; Simmonds *et al.,* 2012). There is ample evidence that the beliefs of patients with LBP are influenced by the beliefs of the health-care provider whom they have consulted (Linton *et al.,* 2002; Vlaeyen and Linton, 2006; Darlow *et al.,* 2012). Furthermore, health-care providers' practice style appears to be associated with patients' outcome (Von Korff *et al.,* 1994).

The available studies on health-care providers' cognitions support the need for implementation research, including the need to identity obstacles impeding delivery of optimal care (Werner *et al.,* 2008). For this purpose, tools assessing health-care providers' attitudes and beliefs are needed but are lacking in Norway. In a critical review of available measurement tools (Bishop *et al.,* 2007), the Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) (Ostelo *et al.,* 2003; Houben *et al.,* 2005b) was one of two most thoroughly tested instruments. Its psychometric properties have recently been systematically reviewed and found satisfactory (Mutsaers *et al.,* 2012). Previous studies have examined the factor structure and internal consistency of the PABS-PT (Ostelo *et al.,* 2003; Houben *et al.,* 2005b; Laekeman *et al.,* 2008). A two-factor solution was consistently found with Cronbach's alpha values ranging from 0.73 to 0.84 for the biomedical factor and from 0.54 to 0.68 for the bio-psychosocial factor. The original PABS-PT was developed by Ostelo *et al.* (2003) and revised by Houben and colleagues with the aim of strengthening the bio-psychosocial sub-scale, which showed poor internal consistency (Houben *et al.,* 2005b). The 19-item version of the scale has been used in a number of studies (Bishop *et al.,* 2008; Bowey-Morris *et al.,* 2010; Overmeer *et al.,* 2011; Simmonds *et al.,* 2012; Hendrick *et al.,* 2013). Although originally developed for physiotherapists, the instrument has also been used to assess medical doctors' conceptions of LBP (Jellema *et al.,* 2005; Watson *et al.,* 2008; Fullen *et al.,* 2008). The scale has further been adapted for beliefs regarding neck pain (Vonk *et al.,* 2009; Mutsaers *et al.,* 2014).

The aim of this study was twofold: (1) to develop a Norwegian version of the PABS-PT and (2) to examine its dimensionality and internal consistency.

Methods

Translation and cross-cultural adaptation

The 36 items included in the Dutch study by Houben *et al.* (2005b) were translated following recommended guidelines (Beaton *et al.,* 2000). The process involved forward and backward translation by four bilingual physiotherapists (two native Norwegian and two native Dutch-speaking) and a professional translator. All translations were reviewed and discussed by an expert panel consisting of three physiotherapists: one bilingual and two with wide experience in clinimetric research methodology. The English version of the PABS-PT was included in this review as supporting information. After consensus was reached, the pre-final version was pre-tested by 21 physiotherapists with background in research, resulting in a final version named PABS-PT-NV (Norwegian version).

Dimensionality and internal consistency

A cross-sectional web-based survey of Norwegian physiotherapists was conducted between February and April 2012. Consent of responders was assumed if they

completed the questionnaire. The study was accepted by the Norwegian Social Science Data Services (project nr. 28806).

The survey encompassed a total of 3849 physiotherapists, divided in two samples of convenience. Sample 1 ($n = 2860$) was recruited by the Norwegian Physiotherapist Association (NPA). Sample 2 ($n = 989$), was recruited by the researchers from membership lists of specialist physiotherapists found on the Internet. Sample 1 comprised all NPA members in four counties, representing the northern, middle, western and southeastern parts of Norway and included all kinds of physiotherapists, such as private practitioners, community and hospital employees, students, retired members and academic non-clinicians. Because current law requires trade unions to anonymize their members' affiliation, details on names, e-mail addresses and professional background of subjects in sample 1 were unknown to us. Consequently, we had no account of non-responders and were not able to send reminders. Sample 2 comprised physiotherapy specialists in sports, rehabilitation, orthopaedics, rheumatology and general practice ($n = 85$), manual therapists ($n = 387$), osteopaths ($n = 127$) and psychomotor (psychosomatic) physiotherapists ($n = 390$).

The instrument

The questionnaire had two sections. The first addressed demographic and practice issues and the second comprised the PABS-PT-NV. A filter question identified therapists who had treated at least one patient with LBP in the previous 6 months and disqualified other therapists from answering the survey.

Demographic and practice information

A number of demographic questions were included, such as gender, age, years of experience, specialty and post-graduate training. Practice questions included work settings and weekly caseload of patients with LBP. We further asked for the responders' professional interest in LBP, own experience of LBP and acquaintance with the national clinical guidelines for LBP. Finally, we asked for the responders' own description of their treatment orientation and outcome goals in their management of LBP.

The Pain Attitudes and Beliefs Scale for Physiotherapists

The PABS-PT is a self-administered instrument developed to discriminate between a predominantly biomedical and bio-psychosocial treatment orientation of physiotherapists towards LBP management (Ostelo *et al.,* 2003; Houben *et al.,* 2005b). Characteristic of a biomedical orientation is the belief that pain and disability are the consequence of specific pathology or tissue damage and that treatment is therefore aimed at signs and symptoms of pathology. Indicative for a bio-psychosocial orientation is the belief that pain and disability not necessarily are signs of tissue damage but can be influenced by psychological and social factors. The developers have stated that the two categories are not opposites of the same scale; the biomedical approach is part of a bio-psychosocial view (Ostelo *et al.,* 2003).

Responders indicate on a 6-point Likert scale (1 = totally disagree, 6 = totally agree) their endorsement on each statement. Treatment orientation is measured on two sub-scales, labelled 'biomedical' and 'biopsychosocial'. Sub-scale scores are calculated by a simple summation of the responses to the sub-scale items. Higher scores on a sub-scale indicate a stronger treatment orientation.

Procedure

A web-based survey was performed following guidelines for Internet E-Surveys (Eysenbach, 2004; Dobrow *et al.,* 2008). E-mail invitations containing an electronic link to the survey were sent by the NPA to sample 1 and by the researchers to sample 2. To avoid sampling twice, participants were asked to disregard the invitation if response had been given in sample 1. Written information was provided regarding the purpose of our study. Participants were instructed that questions in the PABS-PT were only related to non-specific LBP, which excluded LBP resulting from nerve root involvement, cauda equina syndrome, fractures, inflammation, tumours or metastases. Instructions emphasized respondents' personal opinion regarding non-specific LBP in order to avoid response bias towards tissue-based or disease-specific perspectives.

Statistical analysis

Descriptive statistics were used to examine demographic variables of participants. Principal axis factor

analysis with an oblimin rotation was performed, following the procedure suggested by Houben *et al.* (2005a, 2005b). Before examining the factor structure, each item was examined for heterogeneity because this can bias the results of factor analysis (Clark and Watson, 1995). Items were excluded from analysis if skewness and kurtosis were not between −1.5 and +1.5 or if more than 75% of the scores were located in extreme categories (defined as score 1 or 2 for disagreement and score 5 or 6 for agreement). The number of factors extracted was based on the scree plot, the item loading on the different factors and the eigenvalue >1 rule (Kaiser's criterion) (Domholdt, 2000; de Vet *et al.*, 2011). In addition, Horn's parallel analysis was used (software: MonteCarlo PCA by M. Watkins 2000). Items with a factor loading below 0.25 were excluded. If loading on one factor exceeded 0.25 but the difference between loadings on two factors was less than 0.10, items were also excluded. To find out whether factor analysis was appropriate, we checked that the Kaiser–Meyer–Olkin coefficient was ≥0.6 and that the Bartlett test of Sphericity was significant ($p < 0.05$).

Internal consistency was assessed by calculation of Cronbach's alpha of items included in each factor. Alpha values should be above 0.60 and preferably above 0.70 (de Vet *et al.*, 2011). Item–total correlations should be above 0.20, and items with lower correlations were discarded (Streiner and Norman, 2008). The impact on alpha value if an item was deleted was examined next. Pearson's correlation coefficient between the factors was calculated. All statistical analyses were performed utilizing SPSS for Windows, version 18.0.

Results

Translation and cultural adaptation

Nineteen out of 36 translated items were adopted without modifications. A further 12 items needed minor idiomatic adjustments. Five items were considered problematic, mainly because of discrepancies in content and meaning between the Dutch and English versions. The expert panel adopted translations following the Dutch version in four items (items 10, 11, 22 and 29) and produced a compromise in item 35. The back translations confirmed the consistency of the Norwegian version. The PABS-PT-NV is presented in the as online supporting information.

Survey

The overall response rate was 24.8% ($n = 921$). Response rates and composition of the participants are outlined in Figure 1. Reminders were sent to participants in sample 2 only, resulting in a response rate of 47.5%, in contrast to 16.7% in sample 1. Of all responders, 774 had treated at least one patient with LBP in the previous 6 months, which was a premise for being included in the analysis. The demographic and professional characteristics of the responders are summarized in Table 1. The majority of therapists were female (63.2%). About half of therapists (49%) were older than 45 years. Most worked in private practice (79.3%). Patients with LBP comprised 25.8% of the weekly workload. The predominant treatment disciplines were general physiotherapists (33.3%), manual therapists (26.8%) and psychomotor physiotherapists

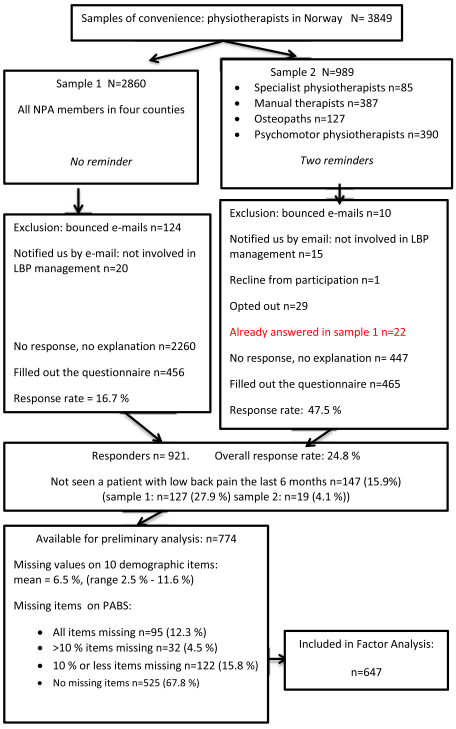

Figure 1. Flowchart: Composition and response rates of the participants. NPA, Norwegian Physiotherapy Association; PABS, Pain Attitudes and Beliefs Scale

Table 1. Characteristics of the participants

	Total sample	Included in factor analysis	Excluded from factor analysis
Number of PTs, *n*	774	647	127
Gender (female), *n* (%)	470 (63.2)	394 (61.9)	76 (71.3)
Age, *n* (%)			
20–35 years	200 (26.5)	176 (27.3)	25 (22.7)
36–45 years	185 (24.5)	162 (25.1)	23 (20.8)
46–55 years	207 (27.5)	175 (27.0)	32 (29.1)
>55 years	163 (21.5)	133 (20.6)	30 (27.4)
Professional background, *n* (%)			
Physiotherapist	250 (33.3)	210 (32.5)	41 (38.4)
Physiotherapy specialist	56 (7.5)	50 (7.8)	6 (5.6)
Manual therapist	201 (26.8)	180 (27,9)	21 (19.6)
Osteopath	50 (6.7)	40 (6.2)	10 (9.3)
Psychomotor physiotherapist[†*]	193 (25.7)	165 (25.6)	28 (26.2)
Years of experience, *n* (%)			
1–10 years	219 (29.2)	192 (29.8)	28 (25.7)
11–20 years	205 (27.3)	177 (27.5)	28 (25.7)
21–30 years	168 (22.3)	138 (21.4)	30 (27.5)
>30 years	160 (21.2)	137 (21.3)	23 (21.1)
Consultations per week			
Mean (SD, range)	39.2 (22.7, 0–120)	39.4 (22.6, 0–120)	36.7 (23.0, 0–100)
Patients with LBP per week			
Mean (SD, range)	10.1 (9.1, 0–60)	10.2 (9.1, 0–60)	8.4 (8.7, 0–50)
Practice situation, *n* (%)			
Private solo practice	113 (16.0)	96 (15.9)	17 (16.8)
Private group practice	446 (63.3)	385 (63.5)	62 (61.4)
Rehabilitation/pain clinic	39 (5.5)	36 (6.0)	3 (3.0)
Hospital	101 (14.3)	84 (13.9)	17 (16.8)
Others	6 (0.9)	4 (0.7)	2 (2.0)
Own experience of LBP, *n* (%)			
None	226 (32.3)	204 (31.5)	22 (40.7)
Experienced acute LBP	227 (32.4)	214 (33.1)	13 (24.1)
Experienced sub-acute LBP	131 (18.7)	125 (19.3)	7 (12.9)
Experienced chronic LBP	116 (16.6)	104 (16.1)	12 (22.3)
Knowledge of clinical guidelines, *n* (%)			
Have read guidelines	317 (45.4)	293 (45.4)	25 (46.3)
Knowledge of main issues	192 (27.5)	180 (27.9)	12 (22.2)
Little knowledge of CG	130 (18.6)	119 (18.4)	11 (20.4)
Have not read CG	59 (8.4)	53 (8.2)	6 (11.1)
Professional interest in LBP, *n* (%)			
Great interest in LBP	110 (14.7)	101 (15.7)	9 (8.5)
LBP is one of more fields of interest	372 (49.7)	314 (48.8)	59 (55.1)
No special interest in LBP	267 (35.6)	228 (35.5)	39 (36.4)
Treatment orientation, *n* (%)			
Pain contingent	225 (37.8)	212 (37.3)	13 (33.3)
Time contingent	54 (8.9)	51 (9.0)	4 (10.3)
Priority on activities and work tasks	153 (25.2)	148 (25.3)	10 (25.6)
Priority on bodily impairment	174 (28.7)	162 (28.2)	12 (30.8)

LBP = low back pain; CG = clinical guidelines. *Specialization in psychosomatic physiotherapy.

(25.7%). Practice experience was more than 10 years for 70.8% of the therapists. With regard to personal factors, 67.7% of therapists reported to have previously experienced LBP themselves. National clinical guidelines had been read by 45.4% of the therapists, while 27.1% reported to have little or no knowledge of the guidelines. Great interest in LBP was reported by 14.7% of the therapists.

The large majority of responders ($n = 774$) completed the first section with the demographic questions,

while 95 (12.3%) had all PABS-PT items missing (Figure 1). Responders who had completed all 36 items of the PABS-PT ($n = 525$) and those with less than 10% missing values ($n = 122$) were included in factor analysis. Missing items from these responders were excluded, while the other items were taken into account. As a result, 647 responders were included in factor analysis. Comparing participants included and excluded in factor analysis (Table 1), a statistical significant difference in the distribution of age categories ($\chi^2 = 14.196$, df = 4, $p = 0.007$) and years of experience categories ($\chi^2 = 9.415$, df = 3, $p = 0.02$) was found, indicating an overrepresentation of older and more experienced participants in the excluded group. No significant differences were found with regard to the other variables.

Data examination

Prior to factor analysis, nine items were excluded because of a skewness or kurtosis not falling between +1.5 and −1.5 or because more than 75% of all scores were located in extreme categories (Table 2). Average scores for these items were lower than 2 or higher than 5.

Factor extraction

The Kaiser–Meyer–Olkin measure (0.826) and the Bartlett's test of sphericity ($\chi^2 = 2650.03$; $p \leq 0.001$) justified the continuation of analysis. The eigenvalue >1 criterion initially suggested the presence of eight factors, together explaining 53.6% of the total variance. Parallel analysis showed four factors. Inspection of the scree plot revealed a clear break after the second factor, suggesting the extraction of two factors. The subsequent forced two-factor solution supported this.

Three items were removed because of factor loadings of less than 0.25 (Table 2). The two-factor solution explained a total of 25.3% of the variance, with factor 1 contributing 18.1% and factor 2 contributing 7.1%. Table 3 shows the descriptives for all items ultimately included in one of the extracted factors and their final rotated factor loadings.

Internal consistency

Initially, factor 1 (17 items) had a Cronbach's alpha value of 0.59. After deleting four items (items 3, 7, 19 and 36), alpha increased to 0.79. This resulted in a 13-item factor. Factor 2 (seven items) had an alpha of 0.55. Deletion of one item (item 2) increased alpha to

Table 2. Descriptives for excluded items; means, SD and reasons for exclusion

No.	Item	Mean (SD)	Reason for exclusion
1	Back pain sufferers should refrain from all physical activity in order to avoid injury	1.5 (0.8)	A
2	Good posture prevents back pain	4.3 (1.2)	C
3	Knowledge of the tissue damage is not necessary for effective therapy	3.0 (1.4)	C
6	Mental stress can cause back pain even in the absence of tissue damage	5.0 (1.0)	A
7	The cause of back pain is unknown	3.3 (1.2)	C
8	Unilateral physical stress is not a cause of back pain	3.0 (1.2)	B
9	Patients who have suffered back pain should avoid activities that stress the back	2.0 (0.9)	A
13	The best advice for back pain is 'Take care' and 'Make no unnecessary movements'	1.5 (0.8)	A
15	Back pain indicates that there is something dangerously wrong with the back	1.5 (0.7)	A
16	The way patients view their pain influences the progress of the symptoms	5.3 (0.8)	A
18	Therapy can completely alleviate the functional symptoms caused by back pain	5.0 (0.9)	A
19	If ADL activities cause more back pain, this is not dangerous	4.2 (1.3)	C
21	Sport should not be recommended for patients with back pain	1.8 (0.8)	A
27	There is no effective treatment to eliminate back pain	2.6 (1.3)	B
28	TENS and/or back braces support functional recovery	3.3 (1.1)	B
32	A rapid resumption of daily activities is an important goal of the treatment	5.3 (0.8)	A
36	In back pain, imaging tests are unnecessary	3.4 (1.2)	C

SD = standard deviation; ADL = Activities of Daily Living.

No. = number of items on questionnaire as administrated. Reasons for exclusion: A = non-heterogeneity (skewness); B = minimal loading; C = rise in alpha if item deleted. Answering alternatives: 1 = 'totally disagree', 2 = 'largely disagree', 3 = 'disagree to some extent', 4 = 'agree to some extent', 5 = 'largely agree', 6 = 'totally agree'.

Table 3. Descriptives (mean, SD), IC and factor loading on both factors (F1 and F2) for items selected during factor analysis

No.	Item	Mean (SD)	IC	F1	F2
25	Increased pain indicates new tissue damage or the spread of existing damage	2.3 (1.0)	0.483	0.699	
20	Back pain indicates the presence of organic injury	2.2 (1.0)	0.429	0.579	
30	If patients complain of pain during exercise, I worry that damage is being caused	2.4 (1.0)	0.433	0.566	
31	The severity of tissue damage determines the level of pain	2.5 (1.2)	0.327	0.563	
24	Pain reduction is a precondition for the restoration of normal functioning	3.6 (1.3)	0.343	0.530	
10	Pain is a nociceptive stimulus, indicating tissue damage	2.9 (1.2)	0.325	0.499	
23	If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term	2.8 (1.2)	0.304	0.490	
14	Patients with back pain should preferably practice only pain free movements	3.0 (1.2)	0.260	0.407	
26	It is the task of the physiotherapist to remove the cause of back pain	2.5 (1.3)	0.252	0.401	
4	Reduction of daily physical exertion is a significant factor in treating back pain	3.2 (1.1)	0.225	0.395	
5	Not enough effort is made to find the underlying organic causes of back pain	3.3 (1.3)	0.212	0.372	
35	In the long run, patients with back pain have a higher risk of developing spinal impairments	3.6 (1.3)	0.196	0.357	
22	If back pain increases in severity, I immediately adjust the intensity of my treatment accordingly	4.6 (1.0)	0.219	0.293	
11	A patient suffering from severe back pain will benefit from physical exercise	4.8 (0.9)	0.203		0.513
33	Learning to cope with stress promotes recovery from back pain	5.0 (0.8)	0.215		0.439
29	Even if the pain has worsened, the intensity of the next treatment can be increased	4.4 (1.0)	0.342		0.438
34	Exercises that may be back straining should not be avoided during the treatment	4.8 (1.1)	0.219		0.402
17	Therapy may have been successful even if pain remains	4.5 (1.1)	0.208		0.333
12	Functional limitations associated with back pain are the result of psychosocial factors	3.8 (1.0)	0.206		0.265

SD = standard deviation; IC = initial communalities.

Items are sorted in descending order based on the factors loadings on factors 1 and 2, respectively.

0.57. This resulted in a six-item factor. There was a moderate negative correlation between the two factors ($r = -0.35$)

The items loading on factor 1 addressed issues like tissue damage, injury, pain as a threat and the importance of reducing or avoiding pain. A high score on factor 1 may therefore represent a biomedical orientation. All items loading on factor 2 addressed issues like the beneficence of exercise and activity, the importance of self-efficacy, the belief that back pain during activity is not dangerous and the recognition that back pain may be related to psychosocial factors. A high score on factor 2 may refer to a bio-psychosocial orientation.

Discussion

The aim of this study was to translate the PABS-PT into Norwegian and examine its dimensionality and internal consistency. Our translation and adaptation procedure was uncomplicated and produced a Norwegian version that we believe is a satisfactory equivalent to the original Dutch PABS-PT. Our analysis confirmed the two-factor structure of the PABS-PT found in previous studies and reduced the scale to 19 items. The results showed that the questionnaire allows a distinction between a biomedical and a bio-psychosocial treatment orientation. Although the internal consistency of the biomedical factor was satisfactory, there is room for further improvement of the bio-psychosocial factor.

Comparing the studies that have examined the factor structure of the PABS-PT (Ostelo *et al.*, 2003; Houben *et al.*, 2005b; Laekeman *et al.*, 2008), the biomedical factor in all versions seems quite robust with regard to the number of included items, while the bio-psychosocial factor is less stable (Table 4). This also accounts for the content of the items making up the two factors: all 10 biomedical items of the Dutch and German versions were included in the Norwegian version, whereas only five Dutch and three German bio-psychosocial items corresponded to our version.

Following the procedure by Houben *et al.* (2005a, 2005b), we excluded nine items from factor analysis because of skewness or because the vast majority of therapists (76.4% to 94.7%) showed extreme scores. Houben *et al.* (2005a, 2005b) and Laekeman *et al.* (2008) excluded eight and 19 items, respectively, for the same reason. Although consistently skewed items are undesirable in factor analysis, even heavily skewed items may assess important construct-relevant information (Clark and Watson, 1995). Our skewed items addressed typical bio-psychosocial issues advocated by guidelines on LBP. Whether important information

Table 4. Comparison of studies assessing factor structure and/or internal consistency of the Pain Attitudes and Beliefs Scale for Physiotherapists

	Factor 1 (biomedical)			Factor 2 (bio-psychosocial)		
	Number of items	Cronbach's alpha	Variance explained (%)	Number of items	Cronbach's alpha	Variance explained (%)
Ostelo *et al.* (2003)	14	0.84	25.2	6	0.54	8.2
Houben *et al.* (2005a, 2005b)	10	0.73	23.4	9	0.68	10
Laekeman *et al.* (2008)	10	0.77	21.5	4	0.58	3.6
Norwegian version	13	0.79	18.1	6	0.57	7.1
Watson *et al.* (2008)	12	0.79	—	5	0.60	—
Magalhaes *et al.* (2011)	10	0.74	—	9	0.67	—

on sub-groups of physiotherapists may have been missed in this way, is not clear and will be examined further.

As in the previous studies, Cronbach's alpha of factor 1 in our study was satisfactory, whereas alpha of factor 2 continued to fall short of recommended values of alpha >0.70 (Table 4), implying that the scale does not capture this dimension sufficiently. Both the study of Laekeman *et al.* (2008) and our study obtained poor alpha values for this factor after translation of the scale, compared with other studies (Houben *et al.,* 2005b; Watson *et al.,* 2008; Magalhaes *et al.,* 2011). One explanation may be the lower number of items (Streiner and Norman, 2008). However, low values of Cronbach's alpha might also indicate that the scale is not entirely homogeneous and that the items on the sub-scale measure a construct that is not yet well defined and precisely demarcated (de Vet *et al.,* 2011). The very modest percentages of explained variance accounted for by the two factors (18.1% and 7.1%) may be indicative for problematic construct validity.

Limitations

We were not able to send reminders to participants in sample 1, which explains the low response rate (24.8%). However, our response rate is still comparable with those of other studies measuring cognitions of health-care providers (Braithwaite *et al.,* 2003; Kaplowitz *et al.,* 2004). Two web-based surveys obtained response rates of 17% and 74%, respectively (Derghazarian and Simmonds, 2011; Hendrick *et al.,* 2013), while those of postal surveys varied from 38% to 51.7% (Houben *et al.,* 2005b; Werner *et al.,* 2005; Pincus *et al.,* 2007; Bishop *et al.,* 2008). Despite the low response rate, our results are strengthened by the large sample size ($n=647$), which allowed for a valid factor analysis of 36 items. However, our convenience sample is not representative for the source population of Norwegian physiotherapists. Specialized physiotherapists accounted for 1525 of a total of 10929 working physiotherapists in Norway in 2011 (source: Statistics Norway and NPA). Of 4240 private practitioners charging reimbursement for physiotherapy treatment, 79% were general physiotherapists, 12.2% were manual therapists and 8.7% were psychomotor physiotherapists (source: National Health Finance Administration). Compared with our sample (physiotherapists 33.3%, manual therapists 26.8% and psychomotor physiotherapists 25.7%), there is an obvious selection bias, with an overrepresentation of specialized physiotherapists. Conversely, a wide variation in population scores is usually required for factor analysis in order to avoid clustering of scores into one or two response categories (de Vet *et al.,* 2011). The participants' different professional backgrounds with diverse opinions seemed to provide this variability sufficiently.

As many as 95 participants (12.3%) provided demographic information but failed to complete any PABS-PT items. A reason could be that the PABS-PT was considered as too extensive. Feedback from responders further indicated that the statements were not considered challenging. However, older responders were significantly overrepresented in non-completing the PABS-PT. Age is a well-known non-response bias in web-based surveys: mail survey responders tend to be older than web survey responders (Kaplowitz *et al.,* 2004). Nevertheless, comparable sizes of our four different age groups indicate that all ages were sufficiently represented in our sample.

Social desirability bias is an actual limitation that may be enhanced in this study. Because therapists are

supposed to be familiar with existing clinical guidelines, responses may have been influenced by an intention to comply with these (Bishop *et al.*, 2007), which implies that participants' knowledge of guidelines and modern pain neurophysiology and management (Nijs *et al.*, 2013) may have been assessed, in addition to their beliefs.

The present study includes only structural validation and examination of reliability, but additional psychometric information such as concurrent validity and test–retest reliability is required to qualify the instruments' integrity. However, the prime aim for further research will be a closer examination of the scale's internal construct validity with regard to unidimensionality (the extent to which items measure a single construct) and the hierarchical ordering of items (indicative for the items' ability to distinguish between distinct levels of treatment approach).

Implications

The PABS-PT-NV seems an adequate instrument to examine Norwegian physiotherapists' pain beliefs and their impact on clinical behaviour and service delivery in the management of LBP. The instrument will provide opportunities to identify educational needs as part of implementation research in order to improve patient care. Norwegian physiotherapists will have to ensure that they are equipped for innovative models of health-care, like direct access and extended scope of practice. Knowledge of therapists' attitudes and beliefs may help tailor the requirements for these new roles. Results from the present study indicate that further research is needed to strengthen construct validity and reliability.

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PAPER II

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Observational study

Rasch analysis resulted in an improved Norwegian version of the Pain Attitudes and Beliefs Scale (PABS)

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HIGHLIGHTS

- Clinicians' pain beliefs are associated with their patients' pain beliefs.
- The PABS measures clinicians' (mal)adaptive pain beliefs regarding LBP.
- Rasch analysis improved the PABS' psychometric properties.
- The results enable confident use of parametric statistical analysis.
- Discriminative ability of the biopsychosocial subscale is limited.

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ABSTRACT

Background and aim: There is evidence that clinicians' pain attitudes and beliefs are associated with the pain beliefs and illness perceptions of their patients and furthermore influence their recommendations for activity and work to patients with back pain. The Pain Attitudes and Beliefs Scale (PABS) is a questionnaire designed to differentiate between biomedical and biopsychosocial pain attitudes among health care providers regarding common low back pain. The original version had 36 items, and several shorter versions have been developed. Concern has been raised over the PABS' internal construct validity because of low internal consistency and low explained variance. The aim of this study was to examine and improve the scale's measurement properties and item performance.
Methods: A convenience sample of 667 Norwegian physiotherapists provided data for Rasch analysis. The biomedical and biopsychosocial subscales of the PABS were examined for unidimensionality, local response independency, invariance, response category function and targeting of persons and items. Reliability was measured with the person separation index (PSI). Items originally excluded by the developers of the scale because of skewness were re-introduced in a second analysis.
Results: Our analysis suggested that both subscales required removal of several psychometrically redundant and misfitting items to satisfy the requirements of the Rasch measurement model. Most biopsychosocial items needed revision of their scoring structure. Furthermore, we identified two items originally excluded because of skewness that improved the reliability of the subscales after re-introduction. The ultimate result was two strictly unidimensional subscales, each consisting of seven items, with invariant item ordering and free from any form of misfit. The unidimensionality implies that summation of items to valid total scores is justified. Transformation tables are provided to convert raw ordinal scores to unbiased interval-level scores. Both subscales were adequately targeted at the ability level of our physiotherapist population. Reliability of the biomedical subscale as measured with the PSI was 0.69. A low PSI of 0.64 for the biopsychosocial subscale indicated limitations with regard to its discriminative ability.

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Conclusions: Rasch analysis produced an improved Norwegian version of the PABS which represents true (fundamental) measurement of clinicians' biomedical and biopsychosocial treatment orientation. However, researchers should be aware of the low discriminative ability of the biopsychosocial subscale when analyzing differences and effect changes.
Implications: The study presents a revised PABS that provides interval-level measurement of clinicians' pain beliefs. The revision allows for confident use of parametric statistical analysis. Further examination of discriminative validity is required.

1. Introduction

Low back pain (LBP) is a frequent reason to seek help from healthcare professionals, including physiotherapists [1]. Although clinical practice guidelines for LBP recommend a biopychosocial approach to care [2], a dominant biomedical approach has been shown to persist among physiotherapists [3–7]. Physiotherapists' beliefs and attitudes have been found to correlate with the advice and treatment provided to patients [8–14] and appear to be associated with patients' outcome [15]. To evaluate attitudes and beliefs among physiotherapists and to measure the effect of interventions aiming to change these attitudes, several questionnaires have been developed [8,9,16–18]. The Pain Attitudes and Beliefs Scale (PABS) [17] is one of the most widely used and thoroughly tested instruments. An amended 19-items version of the scale was developed from 36 items [19] and has been used in a number of cross-sectional and interventional studies [13,20–24]. Although originally developed for physiotherapists, the instrument has also been used to assess medical doctors' conceptions of LBP [25–28]. The scale has further been adapted for beliefs regarding neck pain [29,30].

A recent review concluded that the measurement properties of the PABS, although promising, could still be improved [31]. Previous studies consistently found a two-factor solution with Cronbach's alpha values ranging from 0.72 to 0.84 for the biomedical factor and from 0.54 to 0.68 for the biopsychosocial factor [17,19,32,33]. However, based on low percentages of explained variance of the two factors and the low internal consistency of the biopsychosocial subscale, internal construct validity of the PABS seems problematic. Furthermore, all studies that examined the factor structure of the PABS excluded eight to nineteen items from the original 36-item pool prior to factor analysis because of skewness or because the vast majority of therapists (>70%) showed extreme scores [19,32–34]. Although consistently skewed items are undesirable and may bias the results of factor analysis, these items may capture important construct-relevant information [35]. In fact, such items may actually be the most important in a scale, providing valid scores at the extremes and thus extending the range of coverage on the construct [36].

Modern test theory with Rasch analysis is a sophisticated method for assessing whether a scale is unidimensional (which is considered an essential quality when summing individual items to obtain a valid total score) and whether items exhibit a consistent and invariant hierarchy of difficulty [37–39]. The Rasch model enables analysis of targeting of the items' difficulty to the persons' abilities by calibrating items and persons on a common scale with interval-level units (logits). This transformation from ordinal raw scores into interval-level measures provides greater accuracy when comparing scores between groups of persons and justifies the use of parametric statistics. Alternatively, Rasch analysis may assess whether items function the same way for different groups of persons (e.g. males and females) or not (invariance as determined by Differential Item Functioning), and whether the items' response categories represent the intended logical, increasing level of the underlying trait [40–43].

The aim of this study was to examine the scale- and item performance of the Norwegian version of the PABS and improve its psychometric properties, using Rasch analysis. To test whether reliability could be improved, we re-introduced items which had initially been discarded by the developers of the scale from the original 36-items pool. Furthermore, we wanted to test whether the PABS items were appropriately targeted for a physiotherapist population.

2. Methods

2.1. Design and participants

Data for our analysis of the PABS were collected from Norwegian physiotherapists responding to a cross-sectional web-based survey, as described in detail elsewhere [34]. Briefly, 3849 Norwegian physiotherapists were invited by e-mail to fill out the 36 items of the PABS, together with demographic and professional data. Written information was provided regarding the purpose of our study. Consent of responders was assumed if they completed the questionnaire. The study was accepted by the Norwegian Centre for Research Data (project nr. 28806). Responses from 921 therapists were obtained (response rate 24.8%). Therapists who had not been involved in back pain management for the last 6 months were excluded ($n = 147$). The remaining 774 participants filled out the PABS questionnaire, whereof 679 provided valid PABS scores.

The PABS was initially developed by adapting items from four questionnaires, as well as items developed by the researchers. The instrument aims to discriminate between biomedical and biopsychosocial treatment orientations of physiotherapists in LBP management [17]. Responders indicate on a six-point Likert scale (1 = totally disagree, 6 = totally agree) their endorsement on each statement. Treatment orientation is measured on two subscales, one labelled "biomedical" (10 items), and the other "biopsychosocial" (9 items). Subscale scores are calculated by a simple summation of the responses to the subscale items. Higher scores on a subscale indicate a stronger treatment orientation.

2.2. Data management and analysis

In order to assess whether discarded items from the original 36-item pool may contribute to measurement when added to the original subscales, all 36 PABS items were subjected to exploratory factor analysis (EFA) for assignment to either a biomedical or a biopsychosocial item set. The purpose of this EFA was not a validation of dimensionality, but rather to get an overview of item clustering and to identify a candidate set of items for Rasch analysis. Following principal component analysis with oblimin rotation of the total sample ($n = 667$), 20 items loaded onto the first component (ten items in addition to the original ten biomedical items), whereas 16 items loaded on the second component (seven items in addition to the original nine biopsychosocial items, see the supplementary material of this paper). Subsequently, four item sets were extracted corresponding to the original 10-items biomedical

subscale (BMS-10), the original 9-items biopsychosocial subscale (BPSS-9), an extended 20-items biomedical item set (BMIS-20) and an extended 16-items biopsychosocial item set (BPSIS-16). The four item sets were separately entered into the RUMM2030 software package [44] and examined for item/scale performance, person measurement and scale-to-sample targeting.

The frequency of responses, including missing data, for each item was assessed. Gender and age were entered as person factors. Participants were categorized in five age groups: 20–30 years, 31–40 years, 41–50 years, 51–60 years and over 60 years of age. Significant likelihood ratio tests ($p < 0.0001$) suggested that the partial credit Rasch model was the most appropriate to use for analysis.

2.3. Rasch analysis

The Rasch measurement model presumes that any person should always have a greater probability of receiving a higher score on an "easier" item than on a more "difficult" item and that persons with a high level of the trait should have a higher probability of receiving a higher score on any items compared to persons with lower levels [45]. Essentially, Rasch analysis involves a series of tests to see if the data meet the presumptions of the Rasch model, which besides the above mentioned probabilistic relationship between items (stochastic ordering), include local independency and unidimensionality [37]. When Rasch requirements are fulfilled, the scale's ordinal, raw scores may be transformed into linear, interval level measures and parametric calculations such as means and differences can be applied [36,38,41,43,46].

Overall fit of data to the model was checked with *item-trait interaction statistics*. A non-significant chi squared probability value (Bonferroni adjusted) indicates that the hierarchical ordering of the items is consistent across all levels of the trait and does not compromise the required property of invariance. The fit of individual items and persons was assessed by inspecting their *fit residuals*. This examines the difference between their observed and expected logit values. Potential misfit was considered if fit residuals were beyond standardized $+\pm 2.5$ (99% CI), or if an item showed a significant *chi squared probability* value. High negative fit residuals are normally interpreted to indicate redundancy of an item, whereas high positive fit residuals indicate misfit. The *mean of all fit residuals* across all items of the scale and across all person estimates was examined and should be close to 0 with a standard deviation (SD) close to 1, preferably <1.40.

The assumption of *local response independency* is violated when responses of persons to an item not just depend on their trait level, but on their responses to other test items [47]. Local dependency artificially inflates reliability and results in spurious multidimensionality. Local dependent items were identified through a residual correlation matrix between all items. Two items were considered to be dependent if the residual correlation between them was more than 0.20 above the average residual correlation of all items [48].

Scores on individual items should only be summed if the scale measures one single latent construct. Violation of this assumption of unidimensionality is a potential source of misfit. To test the assumption of *unidimensionality*, independent *t*-tests were carried out on an individual basis. A *t*-test was done for each person, comparing the ability estimates derived from two subsets of the most diverting items [49]. The number of significant *t*-tests in the sample determined the degree of unidimensionality of the scale. Significant multidimensionality was noted to be present if more than 5% of these *t*-tests were significant or if the lower confidence interval of the observed proportion fell below the 0.05 value in a binominal test of averages [50].

Differential Item Functioning (DIF) by gender and age was tested. DIF is identified when subgroups of respondents (e.g. males and females) with the same level of the trait, respond to items differently, thus violating the requirement of invariance.

The *Person Separation Index* (PSI) provides an indication of how reliably the (sub)scale is able to discriminate between person locations and is equivalent to Cronbach's alpha for internal consistency. A PSI >0.70 was considered desirable for group-level comparisons and taken as evidence of sufficient discriminative ability [51].

Targeting of persons and items. Scale-to-sample targeting was made by comparing person locations from the sample with item locations of the scale. Their means should be close to 0 logits with a SD close to 1. A person-item threshold distribution histogram informs about the suitability of the sample for evaluating the scale and the suitability of the scale for measuring the sample.

Response Thresholds Ordering. An increase in response option in items, represented by their transition point between categories (thresholds), should reflect a logical progression of the underlying trait. If this does not occur, response thresholds are disordered. This may be the case when responders cannot reliably distinguish between the presented categories. Ordered response thresholds are a prerequisite to obtain reliable parameter estimates and necessary rescoring by collapsing categories was done before any further scale improvements were attempted [41,52].

For scale refinement purposes, the Rasch analysis was progressed in two alternative ways [53]. In the original two subscales, *resolution A* attempted to account for the misfit that had been highlighted. Resolution A sought to maintain as many original scale items as possible by making the appropriate amendments to account for response dependency and DIF. Where amendments could not be made to account for the source of misfit, individual items were removed from the item set. For local dependency, the dependent items were grouped into "testlets", meaning that the total raw score derived from the items did not change, but the dependent relationship between the items had been eliminated [54,55].

In *resolution B*, misfitting items were removed iteratively to obtain a pure set of items which satisfied all fit parameters. Then, the removed items were individually reintroduced back to see whether or not the original source of misfit was still apparent. If the source of misfit was still present, then the item would again be removed. Resolution B sought to find a set of items, free from any form of significant individual or collective misfit, which act together to form a unidimensional scale [56].

As chi-squared statistics for almost all tests of model fit tend to become significant and will indicate misfit when sample size increases [57], we validated our results by creating two randomized split half samples and then repeat our analyses.

3. Results

The survey collected responses on PABS questionnaires from 679 physiotherapists. Of these, 12 were excluded because responders had not reported gender and/or age. The remaining 667 responders were included in analysis. Distributions of gender-, age- and professional background are shown in Table 1. One hundred and fifty-two responders (22.6%) had one or more missing items. The mean missing data on the PABS statements was 2.9% (range 0.4–5.5%). Missing data were taken into account by RUMM2030 and handled routinely.

3.1. Original biomedical subscale (BMS-10)

Initial analysis of the BMS-10 showed misfit to the Rasch model and slight response threshold disordering of item 24. Individual item fit revealed evidence of four problematic items displaying fit parameters outside the normally expected and accepted range.

Table 1
Characteristics of participants.

Total sample (n = 667)	n (%)
Gender	
Male	251 (37.6)
Female	416 (62.4)
Professional background	
Physiotherapists	216 (32.4)
Physiotherapy Specialists	51 (7.6)
Manual Therapists	183 (27.4)
Osteopaths	44 (6.6)
Psychomotor Physiotherapists	173 (25.9)
Age	
20–30 years	73 (10.9)
31–40 years	188 (28.2)
41–50 years	169 (25.3)
51–60 years	168 (25.2)
>60 years	69 (10.3)

Misfitting items were typically located at the extremes of the continuum. Summery fit statistics are presented in Table 2. Following rescoring of item 24, all items displayed ordered categories. At this stage, response dependency was apparent between item 10, 25, 20 and 22. There was no evidence of DIF by age or gender. Individual item locations on the logit scale, sources of item misfit at this stage and the rescored response code are summarized in Table 3. A hierarchy of item endorsement (ranging from most to least endorsed) across the sample was apparent. Items concerning the belief that tissue damage/structural deficits are important issues in LBP were located at the more "difficult" side of the item hierarchy, characterizing high levels of biomedical attitude when endorsed. Items concerning spinal vigilance and recommendations to adapt activity to pain seemed to cluster at the "easier" side of the hierarchy, characterizing lower levels of the trait (Table 3). The scale-to-sample targeting seemed adequate (Fig. 1). The mean person location (−0.66 logits, SD 0.71, range −3.15 to 1.80) indicated that the subscale was targeted at somewhat higher levels of biomedical treatment orientation possessed by responders in this sample. The item thresholds (range −2.63 to 3.69) spread over a broad range of the construct and exceeded the spread of person measures. A limited spread of the trait in the population could be read from the ten class interval locations ranging from −1.93 to +0.60 logits, thus covering less than three logits.

3.2. Scale refinement of the BMS-10

Despite accounting for response dependency by combining dependent items into testlets and removal of misfitting items, the item set continued to display a high degree of misfitting parameters and resolution A was not reached. Next, a bi-factor solution was sought [58,46], since the BMS-10 was found to split into a negatively and a positively loaded subdomain in the residual correlation matrix; one subdomain referring to a belief that emphasizes tissue damage/structural deficits as an underlying cause of back pain, the other to a belief system that promotes spinal vigilance and restricting activity. This process rendered the subscale unidimensional with satisfactory fit to the model, but with a considerable drop in reliability (PSI = 0.60, Table 2) which made further analysis redundant. Resolution B was reached following the sequential removal of four items (items 20, 22, 25 and 35). The remaining set of six items was strictly unidimensional, invariant and free from any form of misfit, but with an insufficient reliability index (PSI = 0.66, Table 2). The reasons for removing items are listed in Table 4.

3.3. Inclusion of initially discarded items into the biomedical subscale

The original biomedical subscale (BMS-10) was supplemented with 10 items distracted from the original 36-items pool. The resulting item set (BMIS-20) failed to meet Rasch model expectations (Table 2) and eight items displayed disordered thresholds. Following rescoring all items displayed ordered thresholds. At this stage, extensive response dependency was apparent between ten items, whereas four items displayed DIF by gender. Sources of individual item misfit are summarized in the supplementary material of this paper. Scale-to-person targeting was comparable to the original BMS-10, as indicated by its mean person location (−0.88 logits, SD 0.61).

Misfitting and biased items were removed iteratively for scale refinement. The result was a resolution B corresponding to the biomedical 6-items core item set (items 10, 14, 23, 24, 30, 31) supplemented with re-introduced item 4 (*Reduction of daily physical exertion is a significant factor in treating back pain*). This solution was strictly unidimensional and free from any form of misfit, whereas the PSI increased close to recommended values (PSI = 0.69). Reasons for removal of items are listed in Table 4.

3.4. Original biopsychosocial subscale (BPSS-9)

Initial analysis of the BPSS-9 revealed misfit between the data and the model (Table 5). Three items showed fit parameters outside the normally expected and accepted range. Seven of nine items had disordered thresholds, meaning that their response categories

Table 2
Analysis and modification of the original biomedical subscale (BMS-10) and the 20-items extended biomedical item set (BMIS-20).

	Items	Reliability – PSI (alpha)	Item-trait interaction χ^2 probability	Item fit residual Mean (SD)	Person fit residual Mean (SD)	Unidimensionality % significant t-tests (lower CI)	Mean person location (SD)
Initial BMS-10	10	0.74 (0.76)	194.99 (80) p < 0.00001	0.54 (2.23)	−0.389 (1.40)	58 (622) 8.76% (0.07)	−0.65 (0.67)
Rescore BMS-10	10	0.74	246.87 (90) p < 0.00001	0.60 (2.38)	−0.36 (1.35)	63 (662) 9.52% (0.08)	−0.66 (0.71)
Resolution A BMS-10	6	0.67	133.47 (54) p < 0.0001	0.87 (1.40)	−0.32 (1.10)	40 (645) 6.20% (0.05)	−0.61 (0.65)
Bi-factor solution	2	0.60	14.78 (18) p = 0.68*	0.15 (1.70)	−0.60 (0.96)	16 (606) 2.64% (0.009)	−0.23 (0.45)
Resolution B BMS-10	6	0.66	76.17 (54) p = 0.03**	1.05 (1.35)	−0.36 (1.19)	28 (662) 4.23% (0.03)	−0.77 (0.81)
Initial BMIS-20	20	0.81 (0.82)	525.16 (180) p < 0.0001	0.87 (2.22)	−0.22 (1.31)	96 (663) 14.48% (0.13)	−0.79 (0.59)
Rescore BMIS-20	*20*	0.80	5.43.13 (180) p < 0.0001	0.61 (2.44)	−0.21 (1.39)	107 (667) 16.04% (0.14)	−0.88 (0.61)
Resolution B BMIS-20	7	0.69 (0.67)	82.85 (63) p = 0.05***	0.78 (1.27)	−0.37 (1.23)	34 (663) 5.13% (0.03)	−0.68 (0.76)

A non-significant chi squared probability (larger than Bonferroni adjusted p = 0.05): *Bonferroni adjusted value: p = 0.03 for 2 items; **Bonferroni adjusted value: p = 0.008 for 6 items; ***Bonferroni adjusted value: p = 0.007 for 7 items.

Table 3
Original biomedical subscale (BMS-10). Logit measures (locations) and fit statistics of individual items. Summary of individual sources of misfit following rescoring. Item order and mean location (SE) listed from "easy" (likely to be endorsed) to more "difficult" (less likely to be endorsed).

Original item number	Biomedical subscale	Logit measure Mean (SE)	Fit residual <−2.5 or >+2.5	Chi-square probability	Response threshold disordering/rescore coding	Local response dependency Residual correlation (r) > 0.20
22	If back pain increases in severity, I immediately adjust the intensity of my treatment accordingly	−1.62 (0.04)	2.91 (c)	<0.0001*		Item 14 (r = 0.24)
35	In the long run, patients with back pain have a higher risk of developing spinal impairments	−0.56 (0.04)	4.57 (c)	<0.0001*		
24	Pain reduction is a precondition for the restoration of normal functioning	−0.47 (0.07)	−0.06	0.0002*	0-1-1-2-2-3	
14	Patients with back pain should preferably practice only pain free movements	−0.22 (0.04)	2.25	0.197		Item 22 (r = 0.24)
23	If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term	0.21 (0.04)	1.93	0.716		
10	Pain is a nociceptive stimulus, indicating tissue damage	0.29 (0.04)	0.73	0.410		Item 20 (r = 0.30)
31	The severity of tissue damage determines the level of pain	0.44 (0.04)	−0.33	0.039		
30	If patients complain of pain during exercise, I worry that damage is being caused	0.47 (0.05)	−0.10	0.02		
25	Increased pain indicates new tissue damage or the spread of existing damage	0.54 (0.04)	−3.69 (c)	<0.0001*		Item 20 (r = 0.24)
20	Back pain indicates the presence of organic injury	0.90 (0.05)	−1.24	0.006		Items 10 and 25 (r = 0.30 and 0.24)

* Chi squared < the Bonferroni adjusted p-value (=0.005) indicating misfit; (c) = fit residual outside ± 2.5, indicating misfit.

Table 4
Resolution B of the four item sets. Items removed from the subscales and reasons for removal.

Misfit parameter	Items removed			
	BMS-10	BPSS-9	BMIS-20	BPSIS-16
Underdiscrimination (fit residuals > +2.5)	22, 35	7, 27	2, 5, 28, 35	3, 7, 8, 16, 36
Overdiscrimination (fit residuals < −2.5)	25		25	
Response dependency (residual correlation > 0.20)	20, 22, 25	6, 7, 27	1, 9, 13, 15, 20, 21, 22, 25	6, 16, 27, 32
DIF	–		2, 5, 9, 26	36
Significant chi square probability	22, 25, 35	7	2, 13, 15, 21, 22, 25, 28, 35	8, 16, 18, 36

BMS-10: original 10 items biomedical subscale. BPSS-9: original 9 items biopsychosocial subscale. BMIS-20: extended biomedical 20-items set. BPIS-16: extended biopsychosocial 16-items set.

were not functioning as intended. Ten out of the 54 response categories (19%) had no or very few (<10) observations. These null response categories were located in the lowest categories of six items. Category threshold curves for items 6 and 30 are illustrated in Fig. 2.

Following rescoring, overall fit slightly improved and all items displayed ordered categories. At this stage, response dependency was apparent between items 6, 7, 27 and 33. No evidence of any form for DIF was found. The summary fit statistics at this stage are presented in Table 5. Individual item locations on the logit

Table 5
Analysis and modification of the original 9-items biopsychosocial subscale (BPSS-9) and the 16-items extended biopsychosocial item set (BPSIS-16).

	Items	Reliability – PSI (alpha)	Item-trait interaction χ^2 probability	Item fit residual Mean (SD)	Person fit residual Mean (SD)	Unidimensionality % significant t-tests (lower CI)	Mean person location (SD)
Initial BPSS-9	9	0.61 (0.59)	135.91 (81) p < 0.0001	0.56 (1.15)	−0.32 (1.10)	51 (660) 7.74% (0.06)	0.28 (0.59)
Rescore BPSS-9	9	0.60	116.68 (72) p = 0.0006	0.24 (1.25)	−0.37 (1.29)	52 (660) 7.88% (0.06)	0.36 (0.73)
Resolution A BPSS-9	9	0.53	74.72 (48) p = 0.008	0.30 (1.45)	−0.40 (1.167)	44 (656) 6.71% (0.05)	0.38 (0.64)
Resolution B BPSS-9	6	0.61 (0.57)	63.78 (48) p = 0.063*	0.22 (1.00)	−0.40 (1.16)	43 (661) 6.51% (0.05)	0.69 (0.92)
Initial BPSIS-16	16	0.66	285.3 (128) p < 0.0001	0.71 (1.20)	−0.29 (1.26)	104 (663) 15.7% (0.14)	0.28 (0.46)
Rescore BPSIS-16	16	0.63	315.38 (144) p < 0.0001	0.35 (1.40)	−0.32 (1.45)	91 (663) 13.73% (0.12)	0.46 (0.57)
Resolution B BPSIS-16	7	0.64 (0.60)	88.52 (63) p = 0.018**	0.23 (1.20)	−0.40 (1.21)	41 (661) 6.20% (0.04)	0.57 (0.90)

A non-significant chi squared probability (larger than Bonferroni adjusted p = 0.05). *Bonferroni adjusted p = 0.008 for 6 items; **Bonferroni adjusted p = 0.007 for 7 items.

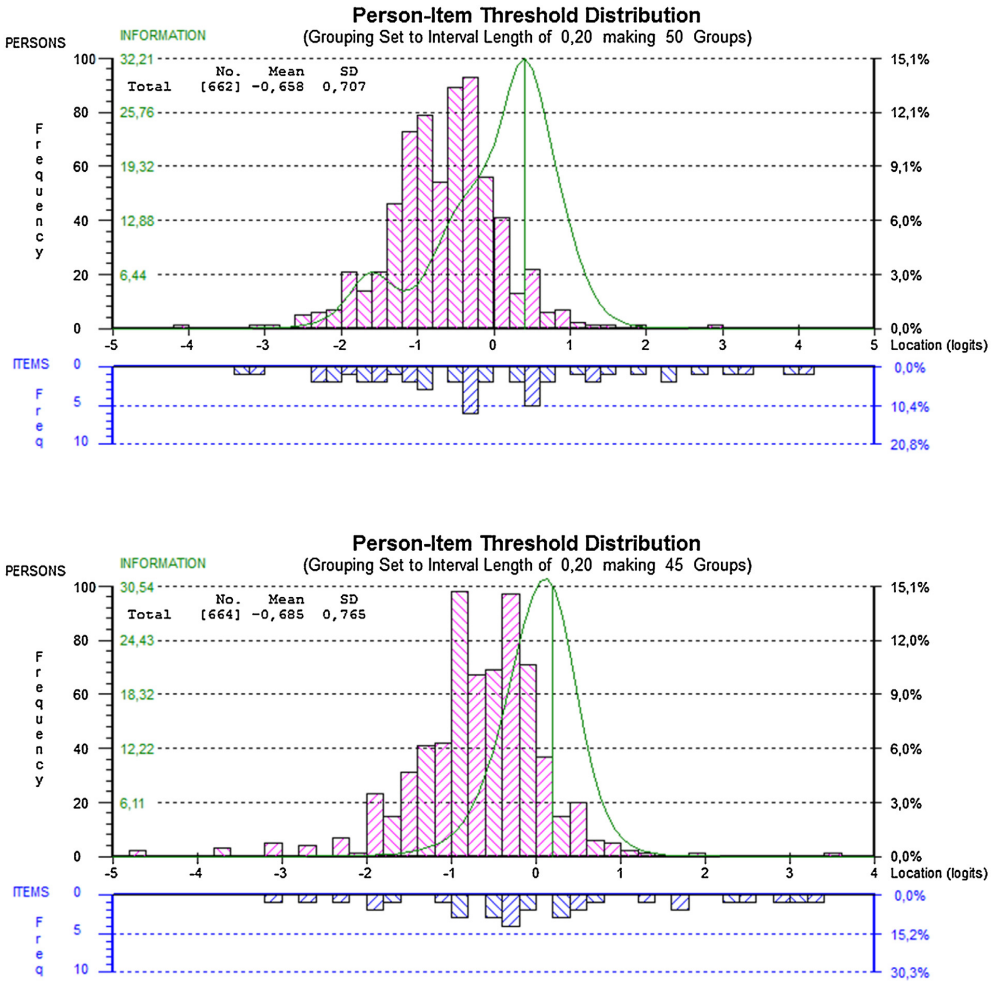

Fig. 1. Upper graph: Person-item threshold distribution of the 10-items biomedical subscale (BMS-10). The distribution of persons (upper plot) and items (lower plot) are compared on the same logit scale. Lower graph: Person-item threshold distribution of the refined, unidimensional 7-items biomedical solution. Item thresholds on the negative end of the continuum are more likely to be endorsed (easy items), whereas items at the positive end are less likely to be endorsed (difficult items).

scale, sources of item misfit and rescore codes are summarized in Table 6.

The scale-to-sample targeting was adequate (Fig. 2). The mean person location (0.36 logits, SD 0.73, range −1.93 to 2.36) indicated that the subscale was targeted at slightly lower levels of biopsychosocial treatment orientation possessed by responders in this sample. The item thresholds covered a wide range of the underlying construct (range −2.84 to 3.43), exceeding the person measures. However, there were gaps between items near the mean person location, indicating a deficiency in measurement capacity. A limited spread of the trait in the population could be read from the nine class intervals which ranged from −0.75 to +2.01, covering less than 3 logits.

3.5. Scale refinement of the BPSS-9

A satisfactory resolution A could not be reached. Despite attempts to account for local dependency, the items set continued to display misfit parameters and weak fit to the model. Resolution B was reached following removal of three items (items 6, 7 and 27). The remaining set of six items was strictly unidimensional, invariant and free from any form of misfit. Reliability remained insufficient (PSI = 0.61). Summary fit statistics are presented in Table 5 and reasons for item removal in Table 4.

3.6. Inclusion of initially discarded items into the biopsychosocial subscale

The biopsychosocial subscale (BPSS-9) was supplemented with seven items distracted from the original 36-items pool. The resulting item set (BPSIS-16) failed to meet Rasch model expectations (Table 5). Twelve out of sixteen items displayed disordered thresholds. Following rescoring, all items displayed ordered thresholds. At this stage, sizeable response dependency was apparent between five items, whereas item 36 displayed DIF by gender. Five items showed fit parameters outside the accepted range. Details on

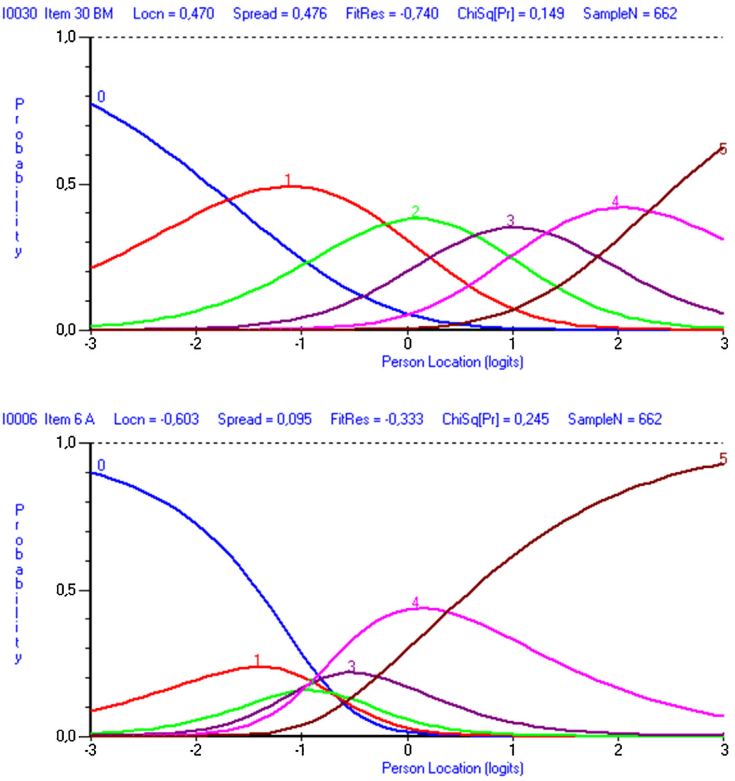

Fig. 2. Category probability curves. In item 30 (upper graph), all response options are ordered. In item 6 (bottom graph), response options 1, 2 and 3 are disordered.

Table 6
Original biopsychosocial subscale (BPSS-9). Logit measures (locations) and fit statistics of individual items after rescoring. Summary of sources of misfit and category disordering with rescore coding. Item order and mean location (SE) from more to less likely to be endorsed.

Original item number		Logit measure Mean (SE)	Fit residual <−2.5 or >+2.5	Chi-squared probability*	Response threshold disordering/rescore coding	Local response dependency Residual correlation >0.20
33	Learning to cope with stress promotes recovery from back pain	−0.93 (0.06)	−0.54	0.019	0-0-0-1-2-3	With item 6 (r = 0.29)
6	Mental stress can cause back pain even in the absence of tissue damage	−0.67 (0.07)	0.22	0.674	0-0-0-1-1-2	With item 33 (r = 0.29)
11	A patient suffering from severe back pain will benefit from physical exercise	−0.65 (0.05)	0.16	0.395	0-1-1-2-3-4	
17	Therapy may have been successful even if pain remains	−0.36 (0.04)	−0.79	0.409		
29	Even if the pain has worsened, the intensity of the next treatment can be increased	−0.31 (0.05)	−1.06	0.399		
34	Exercises that may be back straining should not be avoided during the treatment	−0.12 (0.07)	−0.58	0.02	0-0-0-1-1-2	
12	Functional limitations associated with back pain are the result of psychosocial factors	0.66 (0.06)	0.18	0.70	0-1-1-2-3-4	
7	The cause of back pain is unknown	0.96 (0.05)	2.38	0.0005*	0-1-1-2-3-4	With item 27 (r = 0.29)
27	There is no effective treatment to eliminate back pain	1.42 (0.06)	2.24	0.035	0-1-1-2-2-3	With item 7 (r = 0.29)

* Chi-squared < the Bonferroni adjusted p-value (<0.0055).

sources of individual item misfit and rescore codes are summarized in the supplementary material of this paper.

Scale improvement resulted in a resolution B that was reached after successive removal of nine misfitting or biased items (Table 5). The remaining seven items (core item set 11, 12, 17, 29, 33, 34 in addition to re-introduced item 19 (*If ADL activities cause more back pain, this is not dangerous*) were strictly unidimensional, conforming to the Rasch model and free from any form of misfit and with a PSI of 0.64.

All analyses were repeated using two randomized split half samples ($n = 336$ and $n = 331$) for validation reasons. Comparable fit statistics and resolutions were also found in these two smaller samples, suggesting that sample size did not influence fit to the model in this population.

3.7. Transformation of ordinal raw scores to interval scaling

After fit to the Rasch model was achieved for modifications of the two subscales, we were able to produce transformation tables (see Appendix) that can be used to convert raw ordinal-level scores to interval-level scores. These transformation tables can be used in parametric data analyses when there are no missing data and distributions are appropriate.

4. Discussion

We used Rasch analysis to evaluate the measurement properties of the Norwegian version of the PABS, a questionnaire which is still in a developmental stage. Our analysis suggested that the biomedical and the biopsychosocial subscales require removal of several psychometrically redundant items to satisfy the requirements of the Rasch measurement model. In addition, most biopsychosocial items needed revision of their scoring structure. Furthermore, we identified two candidate items from the original 36-items pool that improved reliability of the subscales when re-introduced. The ultimate result was two strictly unidimensional, invariant subscales, each consisting of seven items and free from any form of misfit. The unidimensionality implies that summation of items to valid total scores is justified. Transformation tables were provided to convert biased ordinal scores to unbiased interval-level scores, which is important when parametric statistical analysis is desired. Both item sets were adequately targeted at the ability level of our physiotherapist population. However, a low PSI (<0.70) indicated problems with reliability and discriminative ability of the biopsychosocial subscale.

4.1. Biomedical subscale

A set of seven items appeared to be the optimal solution for a unidimensional biomedical subscale of the Norwegian PABS version. Item 4 of the original 36-items version qualified for re-introduction. This item has previously been included in another study [34]. Multidimensionality of the original subscale was found to be related to the effects of local response dependency of individual misfitting items. Apparently, responses to these items were dependent on the responses to other items and not just on the persons' trait level. This dependency may be explained by several items concerning tissue damage being too similar to each other. Local response dependency is known to be a factor which spuriously inflates reliability when not addressed [48] and this may explain why the internal consistency of our unidimensional 7-items solution (Cronbach's alpha = 0.67) is lower than values reported in other studies, ranging from alpha = 0.72 to 0.84 [17,19,26,32,33,59]. Reliability values for a bi-factor solution which retained all items, were even lower (PSI = 0.60).

4.2. Biopsychosocial subscale

Our analysis indicated that a set of seven items was the optimal solution for a unidimensional version of the Norwegian PABS. Item 19 of the original 36-items version was re-introduced. This item has previously been included in another study [32]. Removal of misfitting items 6, 7 and 27 was found to improve reliability and rendered a unidimensional biopsychosocial subscale. Apparently, the responses to these items were unrelated to the responses to the remaining items and the underlying trait. Items 7 and 27 seemed to represent an attitude challenging the traditional biomedical perspective and appeared hard to endorse, whereas the other items rather seem to validate a biopsychosocial approach, addressing the beneficial influence of activity despite pain, exercises and positive coping.

Most items of the biopsychosocial subscale were found to have incorrectly ordered response categories that needed to be modified [52]. Rescoring of items was necessary to obtain reliable parameter estimates [52], but had the follow-on effect of reducing the total scale score. With all response options in place, the biopsychosocial solution would be scored 7 to 42, whereas after rescoring the total scale score should be contracted to 7–32. Consequently, information values of any observation will be reduced and the precision of measurement decreased [45,51]. We also found that response categories, mainly in the lower response options of the items, were not fully utilized by the responders. This was evident in our final 7-items solution, where only 15.6% of item responses (range 0.9% to 28.3%) were found in the lower three options of all seven items, indicating large agreement levels on biopsychosocial issues among physiotherapists.

Although our analysis improved reliability of the original 9-items biopsychosocial subscale, separation indexes were still below recommended values for two-group comparisons. The low internal consistency of the biopsychosocial subscale found in other studies has been related to the low number of items [26,32]. However, in this study, the low PSI seems to be a function of the homogeneous group of physiotherapists to which the scale was administered, as shown by the limited distribution range of person locations along the scale (Fig. 2) and the limited variation on the levels of treatment orientation. The PSI depends on how well-targeted the scale is, but moreover on the "ability" distribution of the respondents, as it is harder to separate persons when they are close in ability [57]. Whether the high agreement levels among Norwegian physiotherapists on biopsychosocial issues also account to other countries or other health care professions is unknown and would be a subject for further research.

4.3. Distribution of scores

Although the person item threshold distributions (Figs. 1 and 3) suggested that both subscales were well-targeted, some item thresholds on the end range of the continuum were found to have no discriminative function, as there were no persons at that item locations [60]. Gaps between biopsychosocial items where the largest part of the sample was found indicate that persons cannot be sufficiently discriminated from each other. Apparently, items are needed at the middle/higher range of biopsychosocial orientation, as this is the range where researchers would be more apt to evaluate change over time.

The transformation tables (see Appendix) allow for simple conversion to interval level scores. The use of PABS interval subscales holds important consequences for responsiveness and calculations of aspects such as minimal important change (MIC), since change here is linear throughout the range of the scale [43]. Conversely, small changes in the ordinal score will be more relevant at the margins than in the middle of the scale. As can be seen from

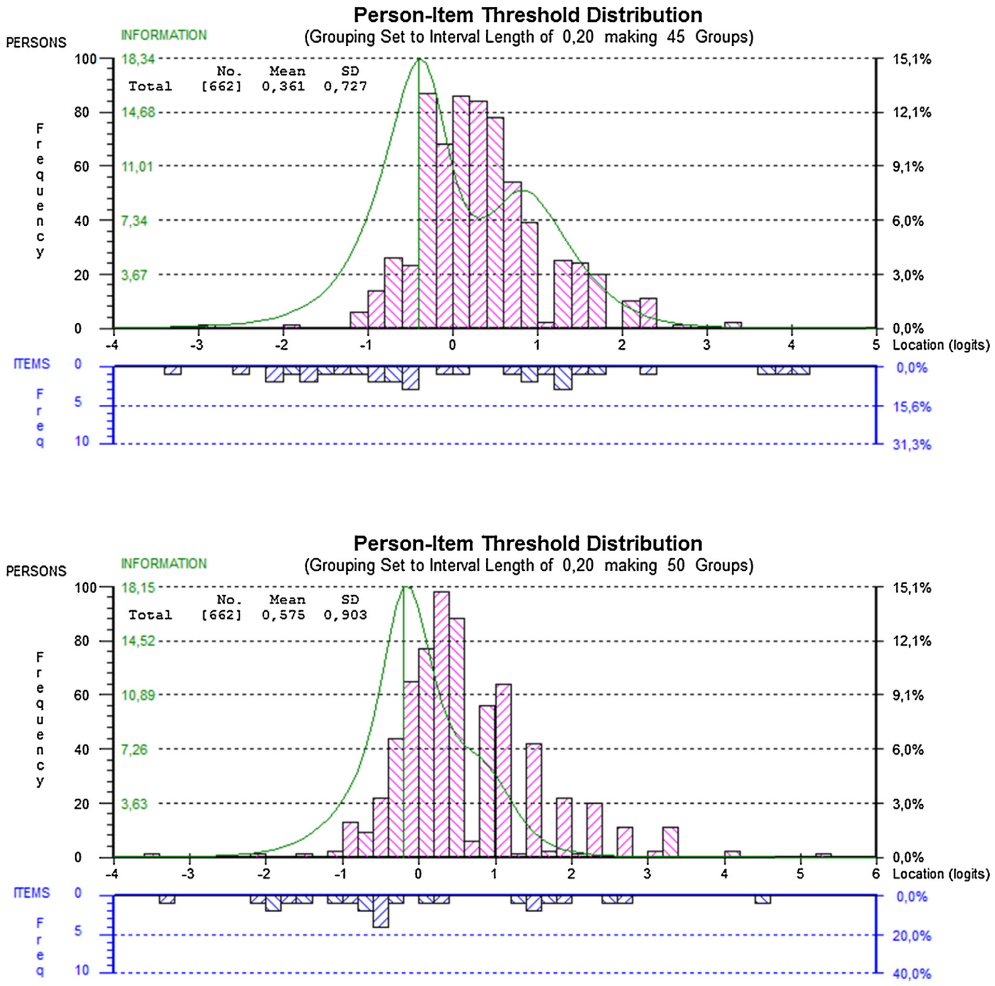

Fig. 3. Upper graph: Person-item threshold distribution graph of the rescored original 9-items biopsychosocial subscale (BPSS-9). Lower graph: Person-item threshold distribution graph of the refined, unidimensional 7-items biopsychosocial solution.

the biopsychosocial transformation table, a raw score change of 3 points represents an interval-level change of at least 3.2 points at the upper or lower margins of the scale, but only 1.4 points in the middle range of the scale. Thus, the interval subscales appear more stable across the construct.

4.4. Strengths and limitations

Previous studies employed factor analysis to reduce the number of items and to determine the dimensionality of the PABS [17,19,21,32–34]. The inconsistent number of items included by these studies might be due to limitations associated with using ordinal data in factor analysis [61,62]. As Rasch analysis constructs linearity out of ordinality and provides item and person location on the variable, it seemed necessary to perform Rasch analysis of a large sample.

One other important reason for using Rasch modelling to evaluate item performance is the ability to examine whether response categories are correctly ordered, i.e. to evaluate whether the responders utilized the response categories as they were intended to (as logical increasing levels of treatment orientation) and that all response categories are utilized [57]. Conversely, classical test theory a priori assumes that response thresholds are ordered. Using a scale with disordered thresholds to detect the effect of interventions is problematic, since it will be difficult or even impossible to evaluate a change in categories [46]. Disordered response thresholds appeared to be a major problem in the biopsychosocial subscale and may have contributed to the limited distribution range of our population and the low reliability. Although all item disordering was resolved by collapsing the disordered thresholds, no substantial improvement in the fit to the model was seen. Hence, disordering could perhaps be explained by the presence of null response categories and not by the responders having problems discriminating between the categories [57].

The large sample size ($n = 667$) provided very robust estimation of the threshold parameters and consequently the response category disordering. However, our convenience sample was not representative for the source population of Norwegian physiotherapists.

An obvious selection bias was present with an overrepresentation of specialized physiotherapists [34]. Conversely, a wide variation in responses from a diversity of clinicians was required in order to avoid clustering of scores [60]. Our sample with different specialties seemed to provide this variability sufficiently.

5. Conclusion

In conclusion, our analysis offers new insights into the internal construct validity of the PABS, including response category functioning. We offer a refined Norwegian version that represents true (fundamental) measurement of biomedical and biopsychosocial treatment orientation. We have provided a transformation table to convert ordinal PABS scores into unbiased interval PABS scores. However, the scale has limitations: The separation index for the biopsychosocial subscale continued to be below recommended values for discriminating between two distinct groups of persons with different levels of the trait.

6. Implications

The revised PABS provides interval-level measurement and allows for confident use of parametric statistical analysis. However, researchers should be aware of the low discriminative ability of the biopsychosocial subscale when used to analyze differences and changes in treatment orientation. Our findings indicate a need for review of the number of response categories in the biopsychosocial subscale to accommodate them to the underlying latent construct. Further research on the scale's discriminative validity is required.

Ethical issues

The study was accepted by the Norwegian Centre for Research Data (project nr. 28806). Consent of responders was assumed if they completed the questionnaire. Written information was provided to responders regarding the purpose of our study.

Conflicts of interest

Nicolaas Eland was supported by the Norwegian Fund for Post-Graduate Training in Physiotherapy in writing the manuscript. The authors report no conflict of interests in relation to this paper.

Appendix A. Conversion table of the modified 7-items Norwegian biomedical subscale

Raw score	Rasch converted score range 7 to 40
7	7.00
8	10.03
9	12.20
10	13.76
11	14.99
12	16.02
13	16.90
14	17.67
15	18.35
16	18.96
17	19.52
18	20.03
19	20.52
20	20.98
21	21.43
22	21.87
23	22.30
24	22.75
25	23.20
26	23.67
27	24.15
28	24.67
29	25.23
30	25.83
31	26.48
32	27.21
33	28.02
34	28.94
35	30.01
36	31.27
37	32.75
38	34.53
39	36.89
40	40.00

Raw data must be adjusted before using the conversion table. Response categories need to be collapsed for item 24. This is done in SPSS using the following recode commands: 1 = 1, 2 = 2, 3 = 2, 4 = 3, 5 = 3, 6 = 4 (Rasch recode 0-1-1-2-2-3).

Appendix B. Conversion table of the modified 7-items Norwegian biopsychosocial subscale.

Raw score	Rasch converted score, range 7 to 32
7	7.00
8	9.51
9	11.22
10	12.38
11	13.27
12	13.99
13	14.61
14	15.16
15	15.67
16	16.14
17	16.61
18	17.07
19	17.54
20	18.03
21	18.56
22	19.13
23	19.77
24	20.46
25	21.23
26	22.08
27	23.01
28	24.05
29	25.26
30	26.77
31	28.92
32	32.00

Response categories need to be collapsed for five of the seven items using the following recode commands: Item 11: 1 = 1, 2 = 1, 3 = 1, 4 = 2, 5 = 3, 6 = 4 (Rasch code 0-0-0-1-2-3). Item 12: 1 = 1, 2 = 2, 3 = 2, 4 = 3, 5 = 4, 6 = 5 (Rasch code 0-1-1-2-3-4). Item 17 need no recoding. Item 19: 1 = 1, 2 = 2, 3 = 2, 4 = 3, 5 = 3, 6 = 4 (Rasch recode 0-1-1-2-2-3). Item 29 need no recoding. Item 33: 1 = 1, 2 = 1, 3 = 1, 4 = 2, 5 = 3, 6 = 4 (Rasch recode 0-0-0-1-2-3). Item 34: 1 = 1, 2 = 1, 31,= 4 = 2, 5 = 2, 6 = 3 (Rasch recode 0-0-0-1-1-2).

Appendix C. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.sjpain.2016.06.009.

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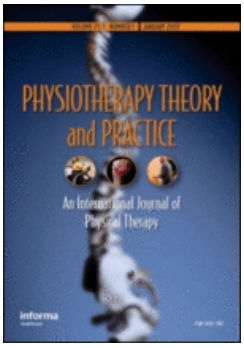
PAPER III

PAPER IV



HOW DO PHYSIOTHERAPISTS UNDERSTAND AND INTERPRET THE "PAIN ATTITUDES AND BELIEFS SCALE"? A COGNITIVE INTERVIEW STUDY

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Word count main text: 5580.

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ABSTRACT

Background: The Pain Attitudes and Beliefs Scale (PABS) for physiotherapists aims to differentiate between clinicians' biomedical and biopsychosocial treatment orientations regarding nonspecific low back pain (LBP). **Objective:** To study the content validity of the Norwegian PABS by following international guidelines: exploring its relevance, comprehensibility and comprehensiveness. **Methods:** Cognitive interviews were performed using the Three-Step Test Interview, consisting of think-aloud techniques, retrospective probing and in-depth interviews. Eleven Norwegian physiotherapists with a diversity of professional backgrounds participated. **Results:** The participants encountered little difficulty in completing the PABS. All items were deemed relevant and important but five items had ambiguous formulations which can easily be handled. The biomedical subscale appeared to be a comprehensive representation of biomedical treatment orientation. The biopsychosocial subscale was found to lack items concerning cognitive behavioral aspects of LBP management, such as patient education, therapeutic alliance, shared decision making and graded exposure. **Conclusions:** This study provides empirical evidence that the Norwegian version of the PABS-PT is relevant and comprehensible, provided some minor adjustments. The biopsychosocial subscale, however, lacks comprehensiveness, as it is not able to capture important aspects of contemporary biopsychosocial best practice care. Measurement of biopsychosocial treatment orientation may therefore be incomplete.

Keywords: Pain Attitudes and Beliefs Scale; Attitudes of Health care professionals: Low Back Pain; Content validity: Cognitive Interview

INTRODUCTION

Low back pain (LBP) is a very common cause of pain-related disability worldwide, constituting a major management challenge for health care providers, including physiotherapists (Hartvigsen et al., 2018; Sanders, Foster, Bishop and Ong, 2013). Over the past two decades, the traditional biomedical view on LBP as a purely patho-anatomical disorder has been greatly challenged (O'Sullivan, 2012; Waddell, 2004). Nonspecific LBP, especially when persistent, is now understood as a complex of symptoms that should be considered within a multidimensional bio-psychosocial framework. Evidence suggests that psychological and social factors are associated with persistent pain and disability and furthermore may act as prognostic indicators of poor outcome (Buchbinder et al., 2018; Foster and Delitto, 2011; Main, Foster and Buchbinder, 2010). Clinical practice guidelines encourage a management approach that is both patient-centered and patient-informed, addressing psychosocial factors and focusing on increasing or maintaining activity and self-management (Bekkering et al., 2003; Koes et al., 2010; Oliveira et al., 2018; Savigny, Watson, Underwood and Guideline Development, 2009). However, adopting a more "psychologically informed" perspective on LBP management may present a challenge for physiotherapists (Main and George, 2011). Data suggests that a significant number of physiotherapists continue to work in an established biomedical practice pattern, characterized by advising their patients to restrict activity, be careful with their backs and reinforcing beliefs in a structural cause of back pain (Ali and Thomson, 2009; Burnett et al., 2009; Cowell et al., 2018; Daykin and Richardson, 2004; Gardner et al., 2017; Oostendorp et al., 2015; Pincus et al., 2007; Poitras, Durand, Cote and Tousignant, 2012; Sanders, Foster, Bishop and Ong, 2013; Swinkels et al., 2005; Synnott et al., 2015).

Available literature suggests that the attitudes, beliefs and preferences of clinicians are associated with their clinical treatment behavior and may serve as obstacles for the delivery of optimal care of patients with LBP (Domenech et al., 2011; Main, Foster and Buchbinder, 2010; Pincus, Vogel and Santos, 2012; Werner et al., 2008). Furthermore, there is strong evidence that the pain beliefs and illness perceptions of patients with LBP are associated with the beliefs and attitudes of the clinicians whom they have consulted (Darlow et al., 2012; Linton, Vlaeyen and Ostelo, 2002; Vlaeyen and Linton, 2006), with a profound influence on patients' outcome (Main, Foster and Buchbinder, 2010).

To gain knowledge on clinician-related factors impeding delivery of optimal care for patients with LBP and improve the implementation of clinical guidelines, a valid and reliable instrument is needed to map physiotherapists' pain beliefs about and attitudes toward persistent LBP (Foster et al., 2003; Pincus, Vogel and Santos, 2012). The Pain Attitudes and Beliefs Scale for Physical Therapists (PABS-PT) is a widely used self-report questionnaire designed to differentiate between clinicians' biomedical and biopsychosocial treatment orientations (Houben et al., 2005; Ostelo et al., 2003). The scale has been used in a number of cross-sectional and interventional studies to measure and evaluate the back-pain beliefs and treatment approaches of physiotherapists, medical doctors and chiropractors (Beneciuk and George, 2015; Bishop, Foster, Thomas and Hay, 2008; Fullen et al., 2011; Hendrick et al., 2013; Innes, Werth, Tuchin and Graham, 2015; Jellema et al., 2005; Overmeer, Boersma, Denison and Linton, 2011; Simmonds, Derghazarian and Vlaeyen, 2012; Sit, Yip, Chan and Wong, 2015; Watson, Bowey, Purcell-Jones and Gales, 2008). The original Dutch version consists of 19 items, however, both shorter and longer versions have been produced after cross-cultural validation into at least 7 languages (Duncan, 2017). A

systematic review concluded that evidence on the measurement properties of the PABS-PT, although promising, was lacking and required further investigation of content validity, interpretability and reliability (Mutsaers et al., 2012). Aiming for further improvement, the Norwegian version was recently subjected to Rasch modelling, resulting in an improved version with two strictly unidimensional subscales and invariant item ordering, each holding seven items (Xxxx, 2016).

The adequacy of an instrument is strongly determined by its validity, that is, the extent to which it accurately measures what it intends to measure (de Vet, Terwee, Mokkink and Knol, 2011). Content validity is considered to be the most important measurement property of an outcome measure and refers to ‘‘the degree to which the content of an instrument is an adequate reflection of the construct to be measured’’ (Mokkink et al., 2010). It deals with the relevance, comprehensiveness, and comprehensibility of an instrument with respect to its construct, target population, and context of use (Brod, Tesler and Christensen, 2009; Patrick et al., 2011, 2011). The US Food and Drug Administration (FDA) (2009) and the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) initiative recommend considering content validity first, when evaluating measurement properties (Prinsen et al., 2016). Lack of content validity influences all other measurement properties: the presence of irrelevant items may lead to decreased internal consistency, unidimensionality and interpretability of the instrument, while the absence of important concepts may reduce responsiveness (Terwee et al., 2018). Conversely, a high Cronbach’s alpha is no guarantee that the construct of interest is being measured or that no important concepts are missing. A high test–retest reliability or responsiveness does not imply that all items are relevant (Terwee et al., 2018).

Although the PABS has been subjected to psychometric scrutiny, there are no reports on how physiotherapists understand, interpret and respond to the items when filling in the PABS. In line with the newly revised COSMIN checklist regarding content validity, focusing on the relevance, comprehensibility and comprehensiveness of items (Terwee et al., 2018), we explored, in a qualitative study, the content validity of the Norwegian version of the PABS for measuring the attitudes and treatment orientations of physiotherapists.

METHODS

Design

We performed individual cognitive interviews of physiotherapists using the Three-Step Test-Interview (TSTI) method (Hak, Van der Veer and Ommundsen, 2006). When preparing the study, we followed the checklist approach of the Cognitive Interviewing Reporting Framework (CIRF) (Boeije and Willis, 2013) and the COSMIN standard for evaluating the quality of content validity studies of PROMs (Terwee et al., 2018). The study was approved by the Norwegian Centre for Research Data (approval xxxxx).

The Pain Attitudes and Beliefs Scale for Physiotherapists

The PABS-PT consists of two subscales and aims to distinguish between a biomedical and a biopsychosocial treatment orientation regarding LBP management (Houben et al., 2005; Ostelo et al., 2003). Each subscale in the Norwegian version contains 7 items. Responders indicate on a 6-point Likert scale (1 = totally disagree, 6 = totally agree) their endorsement of each item, thus generating scores ranging from 7 to 42 points. Higher scores on a subscale indicate a stronger biomedical or biopsychosocial treatment orientation. The conceptual model of the PABS incorporates the influence of clinicians' attitudes, cognitions and back pain beliefs on their treatment behavior (Darlow et al., 2012; Gardner et al., 2017). The developers described a biomedical treatment

orientation as based upon the notion that pain and disability are the consequence of physical pathology or tissue damage. Diagnosis of the pathology provides the basis for treatment, likely resulting in a pain contingent treatment approach, adapting the treatment to the pain level of the patient. A biopsychosocial treatment orientation was described as the notion that pain may also be influenced by psychological and social factors, resulting in a time-contingent treatment approach, emphasizing graded activity according to a previously defined timeframe (Ostelo et al., 2003).

The construct validity and applicability of the PABS-PT is subject to ongoing discussion (Chiarotto et al., 2018; Duncan, 2017; Xxxx et al., 2019; Xxxx, 2016, 2017; Laekeman, Sitter and Basler, 2008; Watson, Bowey, Purcell-Jones and Gales, 2008). Recent testing suggested that the PABS-PT in its original form has limited discriminative ability because of limited spread of scores among physiotherapists (Xxxxl., 2019). This has been hypothesized to be the consequence of a tendency for responders to give socially desirable answers when they are asked for their explicit attitudes toward LBP or of an imprecisely defined conceptual framework of biomedical and biopsychosocial treatment orientation (Xxxx., 2019).

Sampling and Participants

A purposive sample of 11 Norwegian speaking physiotherapists with variation in professional characteristics, age and gender and an interest in LBP management was invited. General physiotherapists, manual therapists, specialist physiotherapists and psychomotor physiotherapists were recruited based on accessibility. Eight physiotherapists were working in primary care physiotherapy clinics, one was working in secondary orthopedic health care and two others were working as respectively a lecturer and a researcher in physiotherapy science. Personal enquiry and snowball sampling were used to recruit participants from a middle-sized university city in

Norway. The participants received verbal and written information on the purpose of the study and procedure for the interview. Written informed consent was obtained prior to the commencement of each interview. The participants were given a small gift, valued up to € 40, - as a gratitude for participation.

Procedure

The interviews were conducted at the participants' workplace or at the University of Bergen by two interviewers (LHM and NE) between September 2018 and April 2019. Both interviewers have long clinical experience as physiotherapists, LHM is currently senior researcher with extensive experience in qualitative research methods. NE is working as a manual therapist in private practice and as a PhD candidate. Complete interviews were audio-recorded and supplemented with field notes. A pilot interview was conducted at the study's start to test the setting, the TSTI procedure and the interview guide. Seven to ten interviews are considered sufficient to confirm participants' comprehensibility of an item, dependent on the complexity of the questionnaire and the characteristics of the target population (Terwee et al., 2018; Willis, 2005). We stopped further data collection when no new themes emerged regarding content validity (Boeije and Willis, 2013). Before stopping, we also considered the variation in participants' subscale scores, as a larger variation possibly reflects a more satisfactory diversity in opinions and perspectives.

The Three-Step Test Interview (TSTI)

The Three-Step Test Interview (TSTI) combines observational and interviewing techniques to identify how items are interpreted and whether problems occur during the completion of the questionnaire (Hak, van der Veer and Jansen, 2008; Paap, Lange, van der Palen and Bode, 2016). The TSTI encompasses three consecutive steps: first, a concurrent thinking aloud phase; second, a retrospective probing phase; and third, a

semi-structured interview. The method has successfully been used before in this field (Pool et al., 2010). During the thinking aloud phase, the participants complete the questionnaire and verbalize their thoughts while doing so. The interviewer does not comment or help, but observes and listens attentively, while taking notes (Bode and Jansen, 2013). In the second, retrospective probing phase, the participants are interviewed regarding their response behavior (Boeije and Willis, 2013): the interviewer uses spontaneous probes to get insight into incomplete observations from phase 1, such as "I saw you hesitate and frown, but what did you actually think when you filled out that question?". In phase three, the semi-structured interview, the participants are invited to explain their earlier comments and to share their opinions about the questionnaire. In this phase, the participants are probed for the comprehensiveness of the questionnaire.

Data Collection

After being instructed on the think-aloud method, the participants completed the 14-item Norwegian version of the PABS-PT, followed by debriefing and a semi-structured interview. An interview guide was produced and, if necessary, modified when new themes emerged after an interview. The interview guide for the semi-structured interview contained open questions about the participant's understanding of the instructions and response options, the intended meaning, comprehensibility and relevance of each item and general questions about the instrument as a whole, including any possible missing conceptual content. We validated throughout the interview by checking our understanding of the participants' comments. At the end of each interview, the co-moderator gave a comprehensive summary of the interview, on which the participant was invited to comment and react. The complete interview guide is provided as supplemental material.

Analysis

The interviews were audio-recorded, transcribed verbatim and analyzed by hand using thematic analysis as described by Willis and Artino (2013). First, participants' statements and comments were arranged in a cognitive interview summary table (Patrick et al., 2011), per item across the three steps of the interview by the first author. Comments made in step three concerning the scale's comprehensiveness were analyzed separately. Next, comments on and interpretations of items were labelled and subsequently categorized per item by the first author. The labels were then analyzed and described. Labels and identified themes were reviewed by a second reviewer (LHM) with reference to the source transcripts, and the joint version was discussed in the whole group of researchers. When unclear, comments and interpretations were illustrated with examples of participant quotes. Analyses and interpretations were done in Norwegian. Summaries of findings and quotations were translated into English, making efforts to retain the original meaning in the Norwegian language. The PABS subscales were considered to fulfill the criteria for sufficient content validity when at least 85 % of their items were relevant for the construct, present no important comprehensibility problems and refer to the construct of interest (Terwee et al., 2018).

RESULTS

The Three-Step Test- Interview proved to be a useful technique. Five themes emerged regarding the relevance and comprehensibility of the individual items, and three themes emerged regarding the comprehensiveness of the scale.

The Three-Step Test Interview

The purposive sample encompassed 11 physiotherapists (6 female and 5 male) consisting of 5 general PTs, 2 manual therapists, 2 psychomotor PTs and 2 specialist PTs. Two participants had a PhD degree and two had a master's degree. Ages ranged

from 24 to 70 years (median 48 years). Clinical experience ranged from one year since graduation until one year before retirement. The cognitive interviews lasted from 32 to 65 minutes (median 44), moreover, the questionnaire took 5 to 20 minutes (median 11) to complete in the think-aloud phase. Often, participants first ticked a response option, followed by explaining their response, rather than reasoning out a response decision. For that reason, the second step of the TSTI (retrospective probing on the participant's response behavior) was unnecessary in many cases. The median biomedical score was 19 points (IQR= 13-24, minimum 11, maximum 27 (theoretical scoring range 7 to 42)); the median biopsychosocial score was 35 points (IQR= 30-36, minimum 23, maximum 39 (theoretical scoring range 7 to 42)). Five participants corrected one or two of their earlier responses after reflection in the third phase of the interview. The response options in the biomedical subscale appeared to be skewed towards the participants' disagreement, except for item 2. Response options in the biopsychosocial subscale were skewed towards agreement, except for item 9 (see Table 1).

Relevance and Comprehensibility of the Individual Items

The participants commented on the comprehensibility of five biomedical and six biopsychosocial items. They reported that four items (biomedical items 1, 4, 7 and biopsychosocial item 14) had to be re-read more than one time before its meaning could be grasped. We identified five categories concerning the relevance and comprehensibility of the individual items:

(1) Difficult or unclear formulations

(2) Items containing problematic words or phrases

(3) Items missing a frame of reference

(4) Participant both agreeing and disagreeing

(5) Items not interpreted as intended

Table 2 summarizes the number of participants' comments in each category for all items. The five categories are presented in more detail below with illustrative participant quotes for some.

Theme (1) Difficult or Unclear Formulations

The participants reported that the items were formulated clearly, except for item 14 ('Exercises that may be back straining should not be avoided during the treatment'). Five participants had trouble responding to this item because of the double negation. Two of them had to re-read the item several times, whereas the other three participants misunderstood and changed their response from disagree to agree after reflection in phase two of the interview. One participant (L) remarked that the formulation in item 8 ('A patient suffering from severe back pain will benefit from physical exercise') is unclear in the context of non-specific LBP:

> This is an unclear and hardly measurable statement. What is 'severe back pain'? (…) Pain is subjective for every single individual. So, I think it is somewhat imprecise.

Theme (2) Items Containing Problematic Words or Phrases

The participants' choice of response options appeared to depend on their perception of "tissue damage" in items 2 and 7. This phrase was by the majority of participants recognized as a soft tissue lesion, such as a contusion, rupture, sprain or inflammatory reaction, not necessarily in connection with LBP. Participant J said on item 7 ('The severity of tissue damage determines the level of pain'):

> I was a bit confused. If you mean a disc protrusion, I wouldn't say it is a tissue damage, I consider it a joint damage.

One participant (E) looked upon tissue damage as aberrant radiological findings in the

lumbar spine. Two participants were unsure about the meaning of "coping with stress" in item 13. Others understood "coping" in connection to pain: "understanding one's pain", having one's pain explained" or "learning to live with back pain". In contrast, the word "stress" was mostly understood as having a demanding life, but also as a bodily phenomenon. Participant J:

> I quite simply image a person that is very tense in many different ways.

Theme (3) Items Missing a Frame of Reference

The participants were indecisive when the meaning of a statement depended on contextual factors that were not mentioned in the item. They typically expressed this by saying, "it depends", meaning that they required a kind of specification.

Five participants (B,E,F,H,L) distinguished between acute and long-lasting complaints while completing items 1, 7 and 9. Participant B said on item 9 ('Functional limitations associated with back pain are the result of psychosocial factors'):

> A premise for a consistent response is a definition of whether this concerns long-lasting or acute complaints.

Furthermore, two participants (B,J) found that items 2 ('Pain is a nociceptive stimulus, indicating tissue damage') and 10 ('Therapy may have been successful even if pain remains') only could provide valid responses when they consider long-lasting complaints.

In addition to unclarity about acute or chronic complaints, five participants (C,D,E,F,H) pointed at a second lack of frame of reference in item 1. The necessity of a "Reduction of daily physical exertions" in treating back pain was considered to depend on what the exertion implies, as heavy physical industrial work differs from an office job.

Participant E said:

> Some exertion should be reduced and avoided, but what is meant by exertion? Exertions may be negative, but when activity is meant, it's positive. Here I agree and disagree, dependent on how physical exertion is defined.

Theme (4) Participants both Agreeing and Disagreeing

Five participants (C,D,E,F,H) tended to both agree and disagree when completing item 2 ('Pain is a nociceptive stimulus, indicating tissue damage'), complicating a consistent response. Participant D:

> Basically, I would say this is a correct statement, however, within the definition of non-specific LBP it is very often wrong.

Three participants (B,D,G) changed their original response in item 9 ('Functional limitations associated with back pain are the result of psychosocial factors') from disagree to agree or vice versa after re-reading and reflecting in the second and third phase of the interview. Participant D:

> I feel for answering both agree and disagree, because psychosocial factors are important (…), but only one of many elements. We cannot really generalize back pain in that way.

One participant (G) changed his response from disagree to agree

> because I misunderstood functional limitations as physical limitations.

Theme (5) Items not Interpreted as Intended

Although an item may be clearly understood, its meaning may be interpreted in a way that is not in line with its intention, affecting the scoring. Six participants (B,C,E,F,H,L) interpreted item 2 ('Pain is a nociceptive stimulus, indicating tissue damage') as a

general statement regarding pain neurophysiology and all were uncertain when responding. In contrast, three participants (D,J,G) reasoned exclusively in the light of non-specific LBP and clearly disagreed. However, responses may be affected by the fact that the Dutch and Norwegian versions of item 2 reads slightly different ('Pain is the result of tissue damage').

Two participants (H,J) interpreted item 3 ('Patients with back pain should preferably practice only pain free movements') as:

> patients with back pain prefer to practice only pain free movements.

Obviously, they agreed on erroneous grounds, because when probed, they explained that pain-free exercises are not always possible, and patients should be challenged on their pain.

Composite formulations may result in unexpected interpretations. The two-part structure of item 4 ('If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term') required some re-reading but lead nevertheless to unexpected interpretation. Participants' responses appeared to depend on which part of the sentence they emphasized. Six participants (B,D,E,F,K,I) emphasized the last part of the item and disagreed, reasoning that there is no strong association between the degree of pain and disability, or that bouts of LBP usually settle by itself. Conversely, four participants (G,H,I,J) agreed, emphasizing the first part and interpreting the item as concerning patient compliance:

> Lacking pain alleviation can in my experience lead to patients losing their faith in recovery, and they may end up in a vicious circle of stress, bad sleep and inactivity (Participant H).

Item 9 ('Functional limitations associated with back pain are the result of psychosocial factors') was by most participants interpreted as: "functional limitations in back pain are associated with psychosocial factors". Two participants interpreted the item correctly as a causal relationship. Participant H:

> If I read this right, it sounds as if functional limitations are the direct result of psychosocial factors.

One participant (D) both agreed and disagreed on the item, because

> When psychosocial factors are concerned, we often expect them to be something basically negative. But psychosocial factors may be positive, like a high degree of self-efficiency.

Reasoning this way, the item obviously makes less sense.

Item 11 ('If ADL activities cause more back pain, this is not dangerous') was by most participants understood as addressing responders' fear avoidance beliefs. However, one participant (I) interpreted the item from an unexpected and unintended perspective:

> Yes, it is dangerous when patients stop living their lives because they have pain in their back.

The participant gave a legitimate response by shifting focus from the patient's back to his/her daily life.

Few participants suggested improvements of individual items. One participant (H) proposed to simplify the text in item 1, for example into "Reducing daily physical exertion is important when you treat LBP". Two participants mentioned that they better understood items 2 and 7 when they imagined "tissue damage" replaced by "lesion".

Comprehensiveness of the scale as a whole

Regarding the comprehensiveness of the scale, the participants were asked about:

(6) Their general impression of the scale, including the introduction, instructions and response options;

(7) Whether there are any missing conceptual aspects and what the scale captures;

(8) The relevance of the items, considering their own clinical experience.

These three themes are presented in detail below with some illustrative participant quotes.

Theme (6) The Participants' General Impression of the Scale

The introduction and the instructions were considered to be clear. The introduction was felt to facilitate responding because specific spinal disorders and pathological changes were excluded and because it was stated that not the knowledge of back pain was tested. Five participants proposed to include in the introduction whether acute or chronic LBP was concerned. Generally, filling in the questionnaire made the participants reflect on their own beliefs and health perspectives. Therefore, some felt a strong urge to provide explanations for their responses.

Four biomedical items (items 1,2,3,4) provoked negative evaluative comments from three participants (C,F,G):

> These are bombastic statements. You can't say that you totally agree or disagree (Participant C).

Response options were considered adequate. However, the ambiguity found in some items made three participants (D,H,J) reflect on the distance or difference between response options.

> The degree between "disagree to some extent" and "agree to some extent", was sometimes difficult to answer. Do I agree or do I disagree? And if I agree, I only agree to some extent (Participant J).

Theme (7) Conceptual Aspects Considered Missing

The participants considered social participation to be missing key concepts in the PABS, although this is an important health promoting factor. Likewise, issues concerning return to work were absent. A psychomotor physiotherapist felt that items relating back pain to patients' narrative were missing. Two others noted to miss cognitive behavioral principles of LBP management, including graded exposure, patient involvement, shared decision making and creating therapeutic alliances. Further, items on patient education about pain physiology were reported missing. One participant missed a consistent tread throughout the questionnaire that could give direction to individual patient management, and illustrated this with a practice example:

> I often start my consultations by saying that in this consultation we will try to answer four questions: First, what do we think is your problem, second, how do you think I can help you. Third, what do you think you must do to help yourself in this situation and fourth, how long will this take? (Participant D).

Theme (8) The Conceived Relevance of the Items

All participants considered every item to be relevant and important, considering their own practice. Two biomedical items were considered especially relevant, as they referred to practical LBP management, like adapting load and exercise to pain (item 1), and whether pain during exercise should be allowed (item 6). Three biopsychosocial items (10, 11, 14) were considered especially relevant, because they invited to reflect on one's own perspective. For example, participant H said on item 10 ('Therapy may have been successful even if pain remains'):

> This item probes who decides if treatment is successful and which criteria for successful treatment should be followed.

The participants described the content of the scale simply as a mapping of physiotherapists' concern to motivate patients for physical activity, their fear avoidance beliefs and beliefs regarding tissue damage and the role of psychosocial factors in back pain.

The participants' own health perspectives and treatment orientations varied widely. Some participants emphasized examination of bodily structures and functions without rushing to assess psychosocial factors, others preferred reassurance, education and explanation on pain mechanisms or building alliances with patients. In general, evaluation of patients' understanding of their LBP was considered very important for education. One psychomotor physiotherapist emphasized body awareness in relation to emotions, rather than physical exercises, as basic aspects in his/her approach.

> Awareness of what is happening in one's body, that's what I see as my most important job as a physiotherapist. That patients get an experience of Self (Participant F).

In contrast, another participant (L) considered an item irrelevant for himself, but not for the physiotherapy profession. He said on item 9 (Functional limitations associated with back pain are the result of psychosocial factors):

> I don't dig into relationship break-ups or psychosocial conditions. I note what patients tell me and that's it. I feel that other therapists are so much better on that, so I refer patients to them.

DISCUSSION

Main Findings

The aim of the present study was to explore the content validity of the PABS for

measuring the biomedical and biopsychosocial treatment orientations of physiotherapists. We followed the recently developed COSMIN methodology for assessing content validity of PROMs and examined whether the items of the two subscales were considered relevant and important, were understood and interpreted as intended and refer to the constructs of interest. Furthermore, we assessed whether there were additional areas of interest that are not covered by the subscales.

The participants had little difficulty completing the PABS. All items were deemed relevant, referring to biomedical or biopsychosocial treatment orientation, and in accordance with physiotherapists' clinical experience. The items were mostly well understood; however, several participants were uncertain whether acute or chronic pain conditions were concerned in some items (biomedical items 1, 2 and 7; biopsychosocial items 9 and 10). Furthermore, a double negation was identified in biopsychosocial item 14 and a somewhat complex formulation was found in biomedical item 4 and biopsychosocial item 9. Although all items concerned conceptual aspects of biomedical and biopsychosocial treatment orientations as intended and defined by the developers, the participants reported to miss items concerning cognitive behavioral aspects of LBP management, such as patient involvement, patient education, therapeutic alliance, shared decision making and graded exposure.

Comparison with Previous Work

The PABS was originally developed by rephrasing items from existing patient reported outcome measures (PROMs) using an expert review procedure (Ostelo et al., 2003). Physiotherapists experienced in chronic pain management and cognitive behavioral therapy were consulted to review these items and develop additional ones. However, validity of the items was not checked other than by looking at their face validity (Houben et al., 2005). Later cross-cultural adaptation studies of the PABS have mostly

relied on a pre-test survey to assess format, comprehensibility and acceptability (Dalkilinc, Cirak, Yilmaz and Parlak Demir, 2015; Xxxx, 2017; Laekeman, Sitter and Basler, 2008; Magalhaes, Costa, Ferreira and Machado, 2011). No problems relating to completion of the questionnaire were reported, and comments received in pre-tests mainly concerned the layout. However, when examining the German version of PABS, Laekeman et al. (2008) found that responders erroneously interpreted the questions of the questionnaire to concern acute LBP. Therefore, the authors recommended to clearly state that the questions concern chronic LBP.

Comprehensibility

In our study, two items tended to elicit rather inconsistent and indecisive responses: participants were unsure whether chronic or acute pain was meant when responding to biomedical item 2 ('Pain is a nociceptive stimulus, indicating tissue damage') and biopsychosocial item 9 ('Functional limitations associated with back pain are the result of psychosocial factors'). In our opinion, most identified problems with PABS can be addressed by minor adjustments of the questionnaire. For example, in items 1, 2, 7, 9 and 10 "back pain" may be replaced by "persistent or recurrent back pain". Alternatively, the instructions, may include a statement clarifying whether (sub)acute or persistent LBP are meant. Also, more consistent responses may be expected when the word "pain" in items 2 and 7 are replaced by "back pain" or the instructions specify that "pain" means "back pain". Some participants overlooked the double negation in biopsychosocial item 14 ('Exercises that may be back straining should not be avoided during the treatment'). Correction of the double negation is difficult, as this would change the item's meaning completely. A better solution would be to underline or capitalize the word "not".

When addressed as outlined above, two minor problems remain. Biomedical item 4 ('If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term') was interpreted differently because of its two-part structure. Biopsychosocial item 9 ('Functional limitations associated with back pain are the result of psychosocial factors') was not interpreted by all participants as the *causal* relationship between functional limitations and psychosocial factors. In an earlier study, this item was found to help identifying responders with the most extreme biopsychosocial attitudes (Xxxx, 2016). One way to facilitate the intended meaning of item 9, is by highlighting the word "result" in bold or italics.

Taking the problematic biomedical item 4 and biopsychosocial item 9 into consideration, six of seven items (> 85%) in each subscale appear to be appropriately worded and comprehensible, provided that all modifiable problems are addressed (Terwee et al., 2018).

Comprehensiveness

The participants acknowledged the PABS-PT as a comprehensive representation of biomedical and biopsychosocial clinical orientation, in line with the developers' definitions (Ostelo et al., 2003). The biomedical items were considered to address the role of tissue damage, pain relief, spinal vigilance, fear avoidance and the believed pain/disability relationship. The biopsychosocial items were considered to address the acceptance of continued normal activity despite pain, and the impact of psychological, social and lifestyle factors on LBP. However, participants commented on missing issues that were related to best practice care, based on cognitive behavioral principles. Several participants emphasized the importance of graded exposure, patient education, addressing patient expectations, cognitive restructuring and enhancing self-efficiency in the management of nonspecific LBP, but these aspects were missing in the PABS. This

emphasis on LBP management issues is reasonable, but basically beyond the intention of the PABS, which is to differentiate between two different health attitudes or treatment orientations. However, the PABS was developed two decades ago: today, the biopsychosocial model is generally (theoretically) accepted in the physiotherapy profession and advocated as best practice care (Wijma, van Wilgen, Meeus and Nijs, 2016) (Lin et al., 2020), although not widely used as a basis for management (Lewis and O'Sullivan, 2018; Synnott et al., 2015; Synnott et al., 2016). Furthermore, studies using the PABS have shown unexpected homogeneity in attitudes among physiotherapists (Xxxx., 2019; Vonk, Pool, Ostelo and Verhagen, 2009). Illustratively, Table 1 shows that our participants were in full agreement on most biopsychosocial items. Our interviews, on the other hand, indicated that the participants had a variety of clinical approaches to LBP management. Therefore, the biopsychosocial subscale seems not comprehensive enough to capture important aspects of contemporary biopsychosocial treatment.

We believe that combining the PABS with other questionnaires may provide broader insights in clinician attitudes and beliefs. Recent studies evaluating the quality and impact of biopsychosocial educational interventions have supplemented the PABS-PT with other questionnaires measuring related biopsychosocial constructs (Bareiss, Nare and McBee, 2019; Beneciuk et al., 2019; Demmelmaier, Denison, Lindberg and Asenlof, 2012; Kongsted et al., 2019; Wang, Fisher and Hall, 2018). These studies used clinician-level questionnaires such as the Practitioner Confidence Scale (PCS) (Bush, Cherkin and Barlow, 1993) to measure clinicians' confidence in managing people with back pain; the Determinants of Implementation Behavior Questionnaire (DIBQ) (Huijg et al., 2014) to measure clinicians' implementation behavior; the Neurophysiology of Pain Questionnaire (NPQ) (Catley, O'Connell and Moseley, 2013) to measure

knowledge of pain physiology and the Patient-Practitioner Orientation Scale (PPOS) (Shaw, Woiszwillo and Krupat, 2012) to measure patient centeredness.

Modification of the PABS-PT to improve content validity is expected to be an extensive and demanding process, which falls outside the score of the present study. Previous attempts to reframe the biopsychosocial subscale by adding items to the original PABS (Houben et al., 2005), or development of a completely new biopsychosocial subscale (Duncan, 2017; Duncan, Foster and Bishop, 2015) did hardly improve the various measurement properties. Careful consideration followed by thorough testing is required before decisions of changes in the questionnaire are made. Our study highlights the themes that should be addressed in future improvement processes.

Strength and limitations

Standards for assessing the content validity of outcome measures were not available when the PABS was developed (Ostelo et al., 2003). The recently developed COSMIN checklist has broadened our understanding of content validity as the most important measurement property of an outcome measure and the most challenging one to assess (Terwee et al., 2018). Our study used the Tree-Step Test-Interview (TSTI) to meet these standards (Hak, Van der Veer and Ommundsen, 2006). The strength of the TSTI is that the think-aloud phase and the semi-structured interview complement each other (Oude Voshaar et al., 2012). Whereas think-aloud reduces interviewer-imposed bias, a semi-structured interview allows the interviewer to focus on relevant areas of interest.

A limitation could be our sample size. Although eleven interviewees should be sufficient according to guideline recommendations (Terwee et al., 2018), there is no guarantee that all important problems relating to content validity are identified, even if saturation is reached (Blair and Conrad, 2011; Perneger, Courvoisier, Hudelson and

Gayet-Ageron, 2015). However, we think that we maximized the detectability of problems by using think-aloud techniques and in-depth cognitive interviews and by thoroughly addressing each PABS item. Furthermore, we aimed to capture all relevant experience by recruiting physiotherapists with a presumed diversity of health perspectives such as manual therapists and psychomotor physiotherapists, as previous qualitative research had found contrasting clinical approaches between these specialties (Thornquist, 1992).

Another limitation is that only one researcher initially coded the key themes and issues, although a second researcher was involved in further reviewing of both codes and themes. Independent coding is ideal to ensure rigor of the analysis and prevent bias, however, it is not a requirement in cognitive interviewing that two researchers analyze the results together (Terwee et al., 2018).

We consider the clinical background and experience of the interviewers a strength when it came to recognize the participants' points of reference. On the other hand, some information on comprehensiveness may have been lost, as certain issues, perceived by the interviewers as self-evident, may not have been brought up.

Relevance of the results

Our study highlights themes that should be addressed in future improvement processes. Until then, the PABS can be expected to perform better with the minor adjustments as proposed in this paper. Furthermore, our methodology and results may be useful in future content validation studies of PABS and other questionnaires. Finally, our results may be used to select and improve items when developing an item bank to measure health care providers' clinical approach in LBP management.

CONCLUSIONS

Our study provides empirical evidence that contents of the Norwegian version of the PABS-PT are relevant and have sufficient comprehensibility to measure physiotherapists' biomedical and biopsychosocial treatment orientation, provided some minor adjustments of the questionnaire. However, the biopsychosocial subscale does not comprehensively reflect contemporary best practice of biopsychosocial care for LBP based on cognitive behavioral principles. Our participants reported on important missing aspects such as patient involvement, therapeutic alliance, shared decision making, patient education and graded exposure. Measurement of biopsychosocial treatment orientation may therefore be incomplete.

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Declaration of interest

The authors report no conflicts of interest.

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Table 1. Distribution of response options among participants B to L for all 14 items of the Pain -Attitudes and Beliefs Scale for Physiotherapists.

Item nr.	Totally disagree	Largely disagree	Disagree to some extent	Agree to some extent	Largely agree	Totally agree
Biomedical subscale						
1. Reduction of daily physical exertion is a significant factor in treating back pain	B,C,L	G,I	E,F,H	D,J	K	
2. Pain is a nociceptive stimulus, indicating tissue damage		D,G	E,IJ,L	B,C,F,H	K	
3. Patients with back pain should preferably practice only pain free movements	D,F	B,G,IL	C,E	J	H,K	
4. If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term	B,F,L	D	E,K	C,G,J	H,I	
5. Pain reduction is a precondition for the restoration of normal functioning	F,G,L	B,H	D,E,J,K	C	I	
6. If patients complain of pain during exercise, I worry that damage is being caused	B,D,F,G,L	C,E,H,J	I,K			
7. The severity of tissue damage determines the level of pain	D,F,G	C,E,H,K,L	B	I		J
Biopsychosocial subscale						
8. A patient suffering from severe back pain will benefit from physical exercise		K	L	J	C,D,F,G,H,I	B,E
9. Functional limitations associated with back pain are the result of psychosocial factors	L		B,D,G,J,K	C,H	E,F,I	
10. Therapy may have been successful even if pain remains				B,H,I,K	C,E,J	D,F,G,L
11. If ADL activities cause more back pain, this is not dangerous		L		I,K	C,D,E,G,H,J	B,F
12. Even if the pain has worsened, the intensity of the next treatment can be increased				I,J,K	C,E,G	B,D,F,H,L
13. Learning to cope with stress promotes recovery from back pain				B,J,L,K	E,G,H,I	C,D,F
14. Exercises that may be back straining should not be avoided during the treatment			C,K	I	D,E,J,L	B,F,G,H

Table 2. Overview of problems encountered and commented by the participants (n=11) when completing the Pain Attitudes and Beliefs Scale for Physiotherapists.

Items		(1) Difficult or unclear formulation	(2) Containing problematic words	(3) Lacking a frame of reference	(4) Agreeing and disagreeing	(5) Not interpreted as intended
	Biomedical subscale	No. of participants indicating problems				
1	Reduction of daily physical exertion is a significant factor in treating back pain			5		
2	Pain is a nociceptive stimulus, indicating tissue damage		2	2	4	6
3	Patients with back pain should preferably practice only pain free movements					2
4	If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term					4
5	Pain reduction is a precondition for the restoration of normal functioning					
6	If patients complain of pain during exercise, I worry that damage is being caused					
7	The severity of tissue damage determines the level of pain		2	3		
	Biopsychosocial subscale					
8	A patient suffering from severe back pain will benefit from physical exercise	1				
9	Functional limitations associated with back pain are the result of psychosocial factors			3	3	2
10	Therapy may have been successful even if pain remains			2		
11	If ADL activities cause more back pain, this is not dangerous					1
12	Even if the pain has worsened, the intensity of the next treatment can be increased					
13	Learning to cope with stress promotes recovery from back pain		2			
14	Exercises that may be back straining should not be avoided during the treatment	5				

APPENDIX 1

4Forskningsgruppe i Fysioterapi - Institutt for Samfunnsmedisinske fag -

1. INTRODUCTION

Dear Colleague,

We kindly ask you to complete this questionnaire to help us explore clinicians' cognitions on nonspecific low back pain.

Usually, clinicians have to consider many different factors in examining and treating patients with low back pain and treatment orientations are often diverging. The purpose of our study is to find out how therapists assess these factors.

The questions in this investigation have been used in several international surveys. The aim of our study is to develop and validate a Norwegian measurement tool that can be used in future research on back pain and clinical practice in Norway.

The survey comprises two parts:

In part one, you are asked for information on your professional background and practice

In part two, you are asked for your opinion as a clinician

Of course, your answers are handled confidentially. Answers cannot be linked to your name or email address. Participation is voluntary. The project has been reviewed and approved by the Norwegian Data Protection Official for Research (NSD).

Thank you for spending your time to participate in our research!

Kind regards,

Research group in physiotherapy, University of Bergen

Nic Eland
Liv Inger Strand
Alice Kvåle

To answer, please tick on an alternative. The first question must be answered before you can continue. If you answer "No" to this question, the survey will be ended.

***1. Have you examined or treated at least one patient suffering from low back pain during the last 6 months?**

- Yes
- No

2. Part 1.Your demographic information

2. Are you male or female?

- male
- female

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3. Your age?

- ○ 20-25 years
- ○ 26-30 years
- ○ 31-35 years
- ○ 36-40 years
- ○ 41-45 years
- ○ 46-50 years
- ○ 51-55 years
- ○ 56-60 years
- ○ 60-67 years
- ○ over 67 years

4. What is your professional background? Please choose an alternative

- ○ Chiropractor
- ○ Manual therapist
- ○ Mensendieck therapist
- ○ Osteopath
- ○ Physiotherapist
- ○ Physiotherapy specialist(allmen, idrett, rehabilitering, ortopedisk, reumatologisk, neurologi, osv)
- ○ Psychomotor physiotherapist

Other(please specify)

5. How many years have you been practicing?

- ○ 1-5 years
- ○ 6-10 years
- ○ 11-15 years
- ○ 16-20 years
- ○ 21-25 years
- ○ 26-30 years
- ○ 30-40 years
- ○ more than 40 years

6. With regard to your present jobb, in what kind of practice do you work?

- ○ Solo practice
- ○ Group practice 2-5 therapists
- ○ Group practice 6-10 therapists
- ○ Group practice, more than 10 therapists
- ○ Rehabilitation Clinic
- ○ Pain Clinic
- ○ Hospital
- ○ Gym Studio

Annet (vennligst spesifiser)

7. How would you describe your interest in low back pain?

- ○ Considerable interest
- ○ Back pain is one of my fields of interest.
- ○ interested alike with other fields of interest

3. PART 1. Your treatment of patients with back pain

8. How many patient consultations do you have in one week?

Number of consultations a week

9. How many patients with low back pain do consult you in one week?

number of patients with back pain in one week

10. Have you been following postgraduate courses in one of the listed treatment methods for back pain?

- ☐ McKenzie
- ☐ Manual therapy (e.g. Maitland, Mulligan etc.)
- ☐ Redcord concept
- ☐ Orthopeadic medicine (Cyriax)concept
- ☐ Cognitive behavioral therapy
- ☐ Medical training therapy
- ☐ Acupuncture/IMS
- ☐ Classification based cognitive functional therapy (O'Sullivan)
- ☐ Basic Body Awareness
- ☐ Feldenkrais
- ☐ Pilates
- ☐ Laser/shockwave
- ☐ Core stability retraining/motor control

Annet (vennligst spesifiser)

4. Part 1. Your own experiences and treatment approach

11. Do you have or have you had low back pain?

- ○ No
- ○ Yes, I have (had) acute low back pain
- ○ Yes, I have (had) back pain that lasted longer than 2 weeks, but shorter than 3 months.
- ○ Yes, I have (had) chronic back pain (lasting longer than 3 months)

12. How would you describe your treatment approach?

- ○ I treat until the patient is (largely) pain free, or until the patient is satisfied with the result
- ○ I prearrange a certain number of treatment sessions or a certain time frame for treatment.
- ○ I treat until the patient can manage his ADL-aktivities or functional work tasks
- ○ I treat until the patient has achieved sufficient strength, mobility and/or motor control.

Annet (vennligst spesifiser)

13. To what degree are you familiar with the national clinical guidelines for treatment of low back pain from the Formidlingsenheten for muskel-og skjelettlidelser (FORMI)?

- ○ I have read the guidelines
- ○ I know the guidelines in broad outline
- ○ I have a nodding acquaintance with the guidelines
- ○ I have not read the guidelines

5. PART 2 of the questionnaire: Health providers pain & orientation scale

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The purpose of part 2 of the questionnaire is to analyse how clinicians approach so-called nonspecific back pain. By nonspecific low back pain we mean back pain that is NOT the result of a radicular syndrome, cauda equina syndrome, fractures, infections, inflammation, tumours or metastasis.

It is not our intention to test your knowledge of back pain or clinical guidelines. We would simply like to know what you think about the treatment of low back pain. We are looking for YOUR opinion; the opinions of others are not relevant.

Part 2 of the questionnaire comprises 36 statements. We would like you to indicate the level to which you agree or disagree with each statement. It is important for our analysis that you mark your opinion on each statement, even when some statements are difficult to answer or seem to overlap with other statements.

14. Ryggsmerter betyr at man må stoppe med fysisk aktivitet for å unngå skade

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

15. En god kroppsholdning forebygger ryggsmerter

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

16. Kunnskap om vevsskaden er ikke nødvendig for å kunne gi en effektiv behandling

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

17. Reduksjon av den daglige fysiske belastningen er en viktig faktor ved behandling av ryggsmerter

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

18. Ved ryggsmerter søkes det for lite etter den underliggende organiske årsaken

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

19. Mental stress kan føre til ryggsmerter, også ved fravær av vevsskade

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

20. Årsaken til ryggsmerter er ukjent

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

21. Ensidig fysisk belastning er ikke årsak til ryggsmerter

Helt uenig | I stor grad uenig | Litt uenig | Litt enig | I stor grad enig | Helt enig

APPENDIX 2

The 14-items, Rasch-modified Norwegian version of the Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT)

Biomedical subscale (7 items)

(Item 4)
Een belangrijk middel bij de behandeling van rugpijn is verminderen van de dagelijkse fysieke belasting
English: Reduction of daily physical exertion is a significant factor in treating back pain
Norwegian: Reduksjon av den daglige fysiske belastningen er en viktig faktor ved behandling av ryggsmerter

(Item 10)
Pijn is het gevolg van weefselschade
English: Pain is a nociceptive stimulus, indicating tissue damage
Norwegian: Smerter er en følge av vevsskade

(Item 14)
Patiënten met rugpijn kunnen beter alleen pijnvrije bewegingsfuncties oefenen
English: Patients with back pain should preferably practice only pain free movements
Norwegian: Pasienter med ryggsmerter bør helst bare øve på smertefrie bevegelser

(Item 23)
Als de behandeling niet leidt tot een afname van rugpijn is er op termijn een groot risico op ernstige beperkingen
English: If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term
Norwegian: Hvis behandling ikke fører til mindre ryggsmerter, er det på lang sikt stor fare for alvorlig nedsatt funksjonsevne

(Item 24)
Pijnvermindering is een voorwaarde om tot functieherstel te komen
English: Pain reduction is a precondition for the restoration of normal functioning
Norwegian: Smertereduksjon er en forutsetning for å oppnå funksjonsbedring

(Item 30)
Als patiënten pijn aangeven tijdens oefenen en/of fysieke activiteiten maak ik mij zorgen dat er iets wordt beschadigd
English: If patients complain of pain during exercise, I worry that damage is being caused
Norwegian: Hvis pasienter angir smerte ved øvelser og/eller fysisk aktivitet, er jeg bekymret for at noe blir skadet

(Item31)
De ernst van de weefselschade bepaalt de hoeveelheid pijn
English: The severity of tissue damage determines the level of pain
Norwegian: Vevsskadens alvorlighetsgrad bestemmer smertenivå

Bio-psychosocial subscale (7 items)

(Item 11)
Bij een patiënt met veel rugpijn is het juist goed om fysieke oefeningen te doen
English: A patient suffering from severe back pain will benefit from physical exercise
Norwegian: Pasienter med mye ryggsmerter har spesielt godt av å gjøre fysiske øvelser

(Item 12)
Functionele beperkingen bij rugpijn zijn het gevolg van psychosociale factoren
English: Functional limitations associated with back pain are the result of psychosocial factors
Norwegian: Funksjonelle begrensninger ved ryggsmerter er en følge av psykososiale faktorer

(Item 17)
Ondanks blijvende pijn kan een behandeling toch geslaagd zijn
English: Therapy may have been successful even if pain remains
Norwegian: Selv om smerten vedvarer, kan en behandling være vellykket

(Item 19)
Als ADL activiteit tot meer rugpijn leidt is dat niet gevaarlijk
English: If ADL activities cause more back pain, this is not dangerous
Norwegian: Hvis aktiviteter i dagliglivet fører til økte ryggsmerter, er ikke dette farlig.

(Item 29)
Ook al is de pijn toegenomen, de patiënt kan toch fysieke oefeningen doen
English: Even if the pain has worsened, the intensity of the next treatment can be increased
Norwegian: En pasient kan gjøre fysiske øvelser, selv om smertene har økt siden forrige behandling

(Item 33)
Leren omgaan met stress bevordert het herstel van rugpijn
English: Learning to cope with stress promotes recovery from back pain
Norwegian: Læring av stressmestring fremmer tilheling av ryggsmerter

(Item 34)
In de behandeling moeten oefeningen die de rug belasten niet geschuwd worden
English: Exercises that may be back straining should not be avoided during the treatment
Norwegian: Øvelser som belaster ryggen må ikke unngås i behandlingen

Eland ND, Kvale A, Ostelo RWJG, Strand LI. Rasch analysis resulted in an improved Norwegian version of the Pain Attitudes and Beliefs Scale (PABS). Scandinavian Journal of Pain. 2016;13 (October):98-108.

Conversion table of the Rasch modified 7-items Norwegian biomedical subscale.

Raw score	Rasch converted score range 7 to 40
7	7.00
8	10.03
9	12.20
10	13.76
11	14.99
12	16.02
13	16.90
14	17.67
15	18.35
16	18.96
17	19.52
18	20.03
19	20.52
20	20.98
21	21.43
22	21.87
23	22.30
24	22.75
25	23.20
26	23.67
27	24.15
28	24.67
29	25.23
30	25.83
31	26.48
32	27.21
33	28.02
34	28.94
35	30.01
36	31.27
37	32.75
38	34.53
39	36.89
40	40.00

Raw data must be adjusted before using the conversion table. Response categories need to be collapsed for item 24. This is done in SPSS using the following recode commands: 1=1, 2=2, 3=2, 4=3, 5=3, 6=4 (Rasch recode 0-1-1-2-2-3).

Conversion Table of the Rasch-modified 7-items Norwegian biopsychosocial subscale.

raw score	Rasch converted score, range 7 to 32
7	7.00
8	9.51
9	11.22
10	12.38
11	13.27
12	13.99
13	14.61
14	15.16
15	15.67
16	16.14
17	16.61
18	17.07
19	17.54
20	18.03
21	18.56
22	19.13
23	19.77
24	20.46
25	21.23
26	22.08
27	23.01
28	24.05
29	25.26
30	26.77
31	28.92
32	32.00

Raw data must be adjusted before using the conversion table. Response categories need to be collapsed for five of the seven items using the following recode commands: Item 11: 1=1, 2=1, 3=1, 4=2, 5=3, 6=4 (Rasch code 0-0-0-1-2-3). Item 12: 1=1, 2=2, 3=2, 4=3, 5=4, 6=5 (Rasch code 0-1-1-2-3-4). Item 17 need no recoding. Item 19: 1=1, 2=2, 3=2, 4=3, 5=3, 6=4 (Rasch recode 0-1-1-2-2-3). Item 29 need no recoding. Item 33: 1=1, 2=1, 3=1, 4=2, 5=3, 6=4 (Rasch recode 0-0-0-1-2-3). Item 34: 1=1, 2=1, 31,= 4=2, 5=2, 6=3 (Rasch recode 0-0-0-1-1-2).

APPENDIX 3

Pain Attitudes and Beliefs Scale for Physiotherapists

The purpose of this list is to help us analyse how you, the therapist, approach the most common forms of back pain. We do not mean back pain resulting from a radicular syndrome, cauda equina syndrome, fractures, infections, inflammation, a tumour or metastasis. It is not our intention to test your knowledge of back pain. We would simply like to know how you approach the treatment of back pain. We are looking for your opinion; the opinions of others are not relevant. We would like you to indicate the level to which you agree or disagree with each statement. 1='totally disagree', 2='largely disagree', 3='disagree to some extent', 4='agree to some extent', 5='largely agree', and 6='totally agree'.

1 Back pain sufferers should refrain from all physical activity in order to avoid injury
2 Good posture prevents back pain
3 Knowledge of the tissue damage is not necessary for effective therapy
4 Reduction of daily physical exertion is a significant factor in treating back pain
5 Not enough effort is made to find the underlying organic causes of back pain
6 Mental stress can cause back pain even in the absence of tissue damage
7 The cause of back pain is unknown
8 Unilateral physical stress is not a cause of back pain
9 Patients who have suffered back pain should avoid activities that stress the back
10 Pain is a nociceptive stimulus, indicating tissue damage
11 A patient suffering from severe back pain will benefit from physical exercise
12 Functional limitations associated with back pain are the result of psychosocial factors
13 The best advice for back pain is: ''Take care'' and ''Make no unnecessary movements''
14 Patients with back pain should preferably practice only pain free movements
15 Back pain indicates that there is something dangerously wrong with the back
16 The way patients view their pain influences the progress of the symptoms
17 Therapy may have been successful even if pain remains
18 Therapy can completely alleviate the functional symptoms caused by back pain
19 If ADL activities cause more back pain, this is not dangerous
20 Back pain indicates the presence of organic injury
21 Sport should not be recommended for patients with back pain
22 If back pain increases in severity, I immediately adjust the intensity of my treatment accordingly
23 If therapy does not result in a reduction in back pain, there is a high risk of severe restrictions in the long term
24 Pain reduction is a precondition for the restoration of normal functioning
25 Increased pain indicates new tissue damage or the spread of existing damage
26 It is the task of the physiotherapist to remove the cause of back pain
27 There is no effective treatment to eliminate back pain
28 TENS and/or back braces support functional recovery
29 Even if the pain has worsened, the intensity of the next treatment can be increased
30 If patients complain of pain during exercise, I worry that damage is being caused
31 The severity of tissue damage determines the level of pain
32 A rapid resumption of daily activities is an important goal of the treatment
33 Learning to cope with stress promotes recovery from back pain
34 Exercises that may be back straining should not be avoided during the treatment
35 In the long run, patients with back pain have a higher risk of developing spinal impairments
36 In back pain, imaging tests are unnecessary

APPENDIX 4

Cognitive interview study of the Pain Attitudes and Beliefs Scale

Interview guide PABS

1. Introducing and chat (5 min)

2. Information to participants regarding the purpose of the interview.

Generally, participants are told about the questionnaire, its use and that we want to test its performance by interviewing physiotherapists.

"The interview is to be used to make the PABS better and develop it further. We want to how easy or difficult it is to fill out the PABS by observing how you respond to the scale. Our intention is to test the quality of the questionnaire, we do NOT want to assess how good you are to respond to the questionnaire. The interview will be audio recorded and we need your consent to that. We have an obligation of confidentiality and we grantee anonymity to all participants. Everything that will be said or done in the interview is bound to confidentiality. Quotations will be used in publications, but without the possibility to identify the person who said it. The audio recording will be transcribed anonymized and stored in a place not assessible to others than the main researcher. This accounts to what you have filled out in the questionnaire and what you have said in the interview. Is there anything that is not clear for you, or do you have questions?"

3. Information about the Think Aloud process

We ask you to say aloud what you think while you complete the questionnaire. We ask you, for the sake of the test, not to comment what you are doing or saying, just to think aloud. You do not have to explain your thoughts. Neither do you have to find up some thoughts just for being able to say anything, for example to avoid silence. You just say the thought that come up naturally while you fill out the questionnaire. In the first part of the interview, I want to know how you respond. In the following parts I want to know why you answered the way you did and I want to know your opinion, but not quite yet. Pretend that I am not here when you fill out the questionnaire.

Phase 1. Think-aloud

A. Exercises to get used to the think aloud techniques (after Willis 1999)

1. When was the last time you had dinner out on a restaurant? Can you tell med everything you think of, while you try to find that date?
2. Can you describe for me last time you were in a shopping center? Tell me in chronological order what you did, from entering the center until you left with the things you had bought.
3. Imagine you are standing in front of your house or apartment. Can you describe your house while you are counting all windows?

B: get written informed consent before starting the interview.

C. Start audio recorder. The participant fills out the questionnaire

Phase 2 Retrospective interview

The objective is to get hold of missing content. Examples:

1. "What did you think when you filled out item 1"?
2. "I saw you frown when filling out item 6. What did you think?"
3.

Phase 3. In depth interview (with 3 to 5 key questions)

A. Questions about the meaning and understanding of the scale

1. How was it to fill out the questionnaire?
2. How was the introduction and the instructions?
3. How were the response options?

B. Questions about every single item, asking for relevance and comprehensibility

1. How do you understand item 1 as a statement? What is this about? What would you say about item 6?
2. Is this an important and relevant question for you and a clinician? Does this item have a place in the attitudinal scale?
3. How do you understand "tissue damage, functional limitations, psychosocial factors, coping stress"?

C. Questions about the construct (comprehensiveness)

The participant is explained that the scale intends to grasp physiotherapist' treatment orientation(health perspectives, which ranges from biomedical (like manipulation) to biopsychosocial (like cognitive behavioral therapy)

1. Does the scale grasp physiotherapists' attitudes? What should I ask you if I wanted to know how you approach low back pain? Your treatment philosophy? Does this questionnaire capture what is important for you in your treatment approach?
2. Is there anything missing in the questionnaire? Do you have any recommendations? What is not capture by this instrument that is important to you?

4. Summary/ closure

Co-moderator summarizes

1. Har I understood you right?
2. Is there anything you want to add to what you have said?

The participants is given thanks and presented with å small gift

APPENDIX 5

Appendix 5. List of studies using the PABS in evaluating the effect of an educational Interventions.

Study	Country	Design	Participants	Outcome measures	Results
Jellema et al. (2005)	Netherlands	Test-retest of educational biopsychosocial intervention versus usual care	General practitioners N=60 Patients, N=314	GP attitudes with PABS GP behavior	Education improved attitudes of GPs,bu did not have a relevant impact on patients' psychosocial factors
Overmeer et al. (2009)	Sweden	Randomized pre-post design	PTs N=42,	PABS-PT, knowledge of psychosocial factors, patient vignette/video	Significant improvement in biomedical and biopsychosocial attitudes in the intervention group. However,, but, patient did not notice any difference in PT behavior
Vonk et al. (2009)	Netherlands	Prospective exploratory study of biopsychosocial training	PTs, MT and behavioral PTs N=42	PABS for neck pain	For behavioral PTs, biomedical scores decreased after education. Biopsychosocial scores shanges were nihil.
Bowey-Morris et al. (2010)	UK	Pre-post design of educational intervention	General practitioners N=73	Educational intervention	Only scores on the biomedical factor changed significantly after MIS
Overmeer et al. (2011)	Sweden	Randomized trial of biopsychosocial educational intervention	PTs N=42	PABS Patient psychosocial outcome	Patient outcome was not dependent on whether therapist attitudes and beliefs had changed Patient outcomes not different for PTs who had followed the course or had not followed the course

Study	Country	Design	Participants	Outcome measure	Results
Demmelmaier et al. (2012)	Sweden	Quasi-experimental single subject design	PTs N=4	PABS, knowledge of yellow flags self-efficacy	Biopsychosocial attitudes toward back pain were congruent with clinical guidelines from the start and were not apparently affected by the intervention.
Rebbeck et al. (2013)	Australia	Prospective longitudinal cohort study of implementation course on whiplash guidelines	PTs chiropractors osteopaths N=94	PABS knowledge	Significant changes in knowledge, biomedical and biopsychosocial beliefsbeliefs BM and BPS
Beneciuk and George (2015)	USA	Longitudinal two-phase study impact of psychologically informed training.	PTs N=12	PABS HC-PAIRS Patient outcome on pain and disability	Education resulted in decreased BM scores and increased BPS scores. PABS scores changed with larger effect sizes than HC-PAIRS Patients improve more in interventions groups
Jacobs et al. (2016)	UK	Pre-posttest of a brief psychologically informed PT training course	PTs N=26	PABS and HC-PAIRS were completed twice on the same day after a course	Large biomedical and biopsychosocial score changes with large effect sizes immediately after the course, large effect size. HC-PAIRS showed moderate changes and effect size.
Richmond et al. (2016)	UK	RCT using an online Cognitive behavior education program	PTs N=25	PABS Cognitive Therapy Scale-Revised-Pain (CTS-R-Pain)	Significant changes in biomedical scores with large effect size after intervention. No improvement in biopsychosocial scores, knowledge, self- efficacy and skills

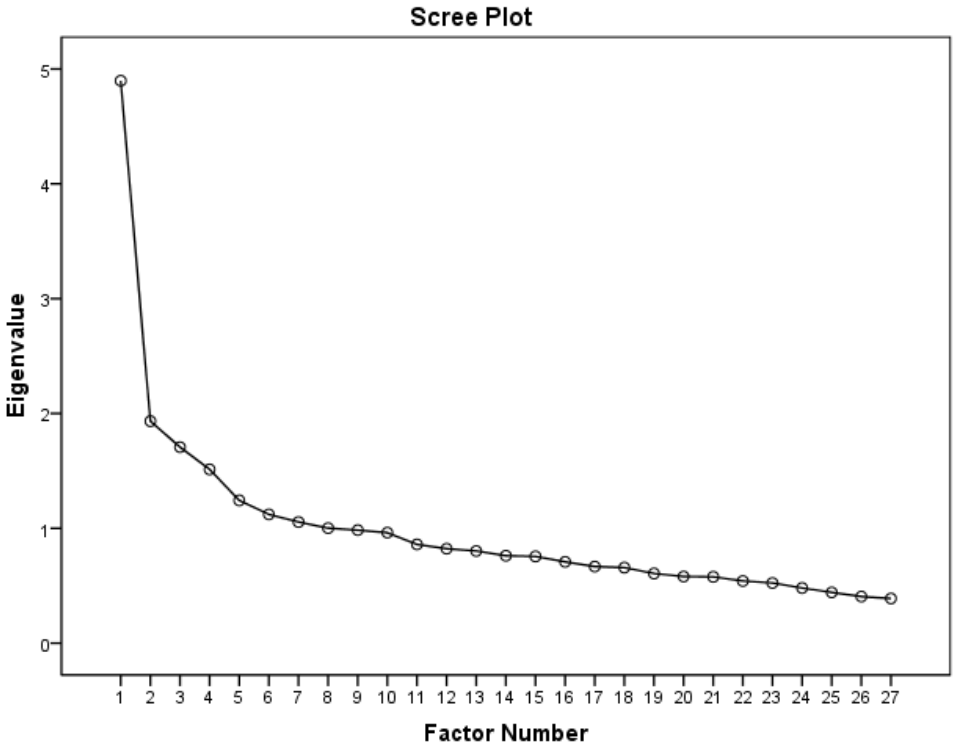
Study	Country	Design	Participnts	Outcome measure	Results
Cox et al. (2017)	USA	Pre- posttest of 3 hours neuroscience education	PT students N=75	PABS HC-PAIRS Neuroscience of Pain Questionnaire	Improved pain knowledge but no change in attitudes and beliefs
Wang et al. (2018)	Australia	Pre post design. Psychologically informed Practice	PTs N=18	PABS -PT Practitioner Orientation Scale (PPOS)	Significant less biomedical scores but unchanged scores on PPOS
Dwyer et al. (2019)	Ireland	RCT using Flag-approach based education	Medical students and GP trainees N=63	PABS-PT The Interpersonal Reactivity Index (IRI) (empathy)	Positive effects of the educational intervention on flags approach knowledge, pain-related attitudes and beliefs, and judgment weighting of psychologically based cues.
Montesinos et al. (2019)	Spain	Pre post design of cognitive behavioral education program	PT students N=35	HC-PAIRS PABS-PT Identification of Spontaneous Response Test	Statistically significant changes on both PABS subscales with small effect sizes No significant changes in HC-PAIRS not
Kongsted et al. (2019)	Denmark	RCT Feasibility study of a self-management approach	PTs N=31	PABS-PT Practitioner Confidence Scale (PCS)	A small average change was observed over time towards a less biomedical (mean change − 4.2, SD = 6.4) and more behavioral orientation (mean change 2.1, SD = 4.4)
Beneciuk et al. (2019)	USA	Test-retest educational program Psychologically informed physiotherapy	PTs N=55	PABS Confidence in implementing psychologicaly informed practice	PABS-PT biomedical scale scores decreased from 31.1 (SD = 6.8) to 25.0 (SD = 7.1) ($P < 0.001$), and behavioral scale scores increased from 36.8 (SD =4.8) to 41.4 (SD =5.2) ($P < 0.001$).

APPENDIX 6

Appendix 6. Studies with data on the attitudes and beliefs of physiotherapists and other health care providers used in our hypothesis-testing.

Studies of physiotherapists	Sample	Studies of other HCP	Sample
Domenech et al. (2011)	Physiotherapy students Spain	Pincus et al. (2007)	Physiotherapists, osteopaths, chiropractors UK
Simmonds et al. (2012)	Physiotherapists Canada	Rainville et al. (2000)	Ortopedic spine surgeons General practitioners USA
Darlow et al. (2012)	Systematic review including medical and paramedical therapists. New Zealand	Linton et al. (2002)	General practitioners physiotherapists Sweden
Houben et al. (2005)	Physiotherapists, manual therapists, chiropractors Netherlands	Watson et al. (2008)	General practitioners UK
Ostelo et al. (2003)	Physiotherapists, manual therapists, chronic pain therapists	Fullen et al. (2011)	General practitioners Ireland
Ferreira et al. (2004)	Physiotherapy students Brazil and Australia	Sit et al. (2015)	General practitioners Hong Kong
Latimer et al. (2004)	Physiotherapy students. Australia	Innes et al. (2015)	Chiropractors. Australia
Houben et al. (2005)	Physiotherapy students Netherlands	Cherkin et al. (1988)	General practitioners and chiropractors. USA
Vonk et al. (2009)	Physiotherapists, manual therapists, behavioral therapists Netherlands	Coudeyre et al. (2006)	General practitioners France
Magalhaes et al. (2012)	Physiotherapists Brazil.	Werner et al. (2008)	General practitioners, physiotherapists, and chiropractors. Norway.
Thornquist (2006)	Qualitative study of a manual therapist and a psychomotor physiotherapist Norway	Fullen et al. (2008)	General practitioners Systematic review
		Buchbinder et al. (2009)	General practitioners Australia
		Burnett et al. (2009)	Nursing and physiotherapy students Australia, Taiwan, Singapore
		Briggs et al. (2013)	Students in chiropractic, medicine, occupational therapy, pharmacy and physiotherapy. Australia
		Kennedy et al. (2014)	Students in physiotherapy, medicine, nursing and midwifery Ireland
		Tan et al. (2014)	Medical practitioners, physiotherapists, nurses, occupational therapists China
		Sieben et al. (2009)	General practitioners Netherlands

APPENDIX 7.



Appendix 7. Screeplot.

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