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Assessing future health care practitioners' knowledge and attitudes of musculoskeletal pain; development and measurement properties of a new questionnaire

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A R T I C L E I N F O

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A B S T R A C T

Background: Healthcare practitioner beliefs influence patients' beliefs and health outcomes in musculoskeletal (MSK) pain. A validated questionnaire based on modern pain neuroscience assessing Knowledge and Attitudes of Pain (KNAP) was unavailable.
Objectives: The aim of this study was to develop and test measurement properties of KNAP.
Design: Phase 1; Development of KNAP reflecting modern pain neuroscience and expert opinion. Phase 2; a cross-sectional and longitudinal study among Dutch physiotherapy students.
Method: In the cross-sectional study (n = 424), internal consistency, structural validity, hypotheses testing, and Rasch analysis were examined. Longitudinal designs were applied to analyse test-retest reliability (n = 156), responsiveness, and interpretability (n = 76).
Results: A 30-item KNAP was developed in 4 stages. Test-retest reliability: ICC (2,1) 0.80. Internal consistency: Cronbach's α 0.80. Smallest Detectable Difference 90%: 4.99 (4.31; 5.75). Structural validity: exploratory factor analysis showed 2 factors. Hypotheses testing: associations with the Pain Attitudes and Beliefs Scale for Physiotherapists biopsychosocial subscale r = 0.60, with biomedical subscale r = −0.58, with the Neurophysiology of Pain Questionnaire r = 0.52. Responsiveness: 93% improved on KNAP after studying pain education. Minimal Important Change: 4.84 (95%CI: 2.77; 6.91).
Conclusions: The KNAP has adequate measurement properties. This new questionnaire could be useful to evaluate physiotherapy students' knowledge and attitudes of modern pain neuroscience that could help to create awareness and evaluate physiotherapy education programs, and ultimately provide better pain management.

1. Introduction

Health Care Practitioners' (HCPs) biomedical attitudes and beliefs about musculoskeletal (MSK) pain have a negative influence on patients' beliefs and health outcomes (Gardner et al., 2017; Darlow et al., 2012; Nijs et al., 2013; Foster and Delitto, 2011; Domenech et al., 2011; Parsons et al., 2007; Rainville et al., 2000; Houben et al., 2005a; Ostelo and Vlaeyen, 2008). The ability of HCPs to identify their beliefs about MSK pain is crucial given the significant role practitioners can play in achieving patients' biopsychosocial beliefs about low back pain (LBP) (Sullivan, 2011; Darlow, 2016; Lakke et al., 2015). Identifying HCPs' beliefs that may contribute to suboptimal clinical outcomes is a relevant prerequisite towards improving the quality of patient care (Moran et al., 2017). Pain Neuroscience Education (PNE) is a cognitive-based intervention to teach people about pain biology and physiology and de-emphasise the issues associated with the anatomical structures and focus on the biopsychosocial factors that contribute to the development of pain (Louw et al., 2016; Ryan et al., 2010; Nijs et al., 2014; Foster et al., 2003; Butler and Moseley, 2013). Given the influence of HCPs on a patient's recovery from MSK pain by providing PNE and designing and testing education programs on pain, assessing knowledge and attitudes of modern pain neuroscience of HCPs, including future HCPs, is needed.

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Questionnaires are available that aim to evaluate knowledge, attitudes, and beliefs among HCPs (Moran et al., 2017; Bishop et al., 2007; Darlow et al., 2014; Waddell et al., 1993; Domenech et al., 2013; Pincus et al., 2006; Houben et al., 2004). Because there is no gold standard for assessing knowledge and attitudes of pain among students (Ung et al., 2016), the Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) and the Neurophysiology of Pain Questionnaire (NPQ) were added as secondary measures. One of the most thoroughly tested instrument is the PABS-PT (Ostelo et al., 2003; Houben et al., 2005b), developed in 2003. Over time, the PABS-PT does not fully align with current pain neuroscience; relevant topics concerning pain biology and physiology as the adaptation of the pain system, central sensitisation of the nervous system, the top-down and bottom-up systems, and the pain neuromatrix are not included. Moreover, the PABS-PT aims to measure attitudes and beliefs, not current pain knowledge, which is an important outcome measure of PNE. Furthermore, the measurement properties are suboptimal; information on interpretability and content validity is lacking and the biopsychosocial subscale, as well as the separate PABS-PT subscales, contains low discriminative ability (Mutsaers et al., 2012; Eland et al., 2016, 2018). The NPQ (Moseley, 2003) measures knowledge, but not attitudes, of HCPs and its psychometric properties have only been partially examined. Suboptimal and psychometrically unnecessary items of the NPQ need further examination (Catley et al., 2013; Meeus et al., 2010). Also, the true-false nature of results of the questionnaire is susceptible to interpretation and thereby the NPQ is limited in content validity.

Therefore, we developed a new questionnaire called KNowledge and Attitudes of Pain (KNAP). KNAP aims to assess both knowledge about modern pain science and biopsychosocial attitudes towards pain in HCPs. KNAP is based on the online pain education course' Understanding Pain' of the Retrain Pain Foundation. (Schneider, DiLillo, Hullstrung) This study aimed to develop KNAP and to extensively test its measurement properties in a sample of physiotherapy students in the Netherlands. A future step will be to adjust and validate the KNAP for active HCPs. The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) was applied (Mokkink et al., 2010a).

2. Methods

2.1. Phase I - development

Four steps were taken for developing KNAP to develop its content validity, including face validity (Terwee et al., 2018). Step 1. Items were created based on the online pain education course "Understand Pain" of the Retrain Pain Foundation. (Schneider, DiLillo, Hullstrung) Step 2. These items were reviewed by the researchers (AB, RR, DP) on content and face validity. Missing and deemed important items were added. Step 3. An expert review procedure was performed: a survey containing a set of resulting items were sent online to 10 experts. These experts are experienced researchers combining research with educational or clinical activities in the field of (persistent) pain in the Netherlands or Belgium. They were asked to judge relevance and comprehensiveness in the context of measuring knowledge and attitudes of pain (Terwee et al., 2018). Researchers (AB, RR, DP) processed the answers. Step 4. The Dutch KNAP was translated forward and backward (Beaton et al., 2000). The English KNAP was tested in a sample of students of the International Program Physiotherapy (n = 36). During these procedures, the understanding of the instructions, the purpose of the items, the wording of the items, and the response options were evaluated. This step resulted in some textual changes of items, also in the Dutch KNAP. Two Dutch physiotherapy students filled in the pre-final version to determine the completion time and feasibility of the KNAP.

2.2. Phase II - testing measurement properties

2.2.1. Design and participants

A cross-sectional survey was conducted among all registered students of the 4-year entry-level physiotherapy education program at the Hanze University of Applied Sciences in Groningen, the Netherlands (T0). To study test-retest reliability, the measurements were repeated three weeks later among students of year 1–3 (T1). No pain neuroscience education (PNE) was given between T0 and T1. Approximately one year after T1, another group was measured after studying the PNE course (T2). The ten weeks PNE course was delivered during three sessions of 1 h and three sessions of 2 h. Lectures and practical sessions (practising PNE) were given about the biology of pain, the differences between acute and chronic pain, top-down and bottom-up systems, central sensitisation of the nervous system and the pain neuromatrix based on the books 'Pijneducatie, een praktische handleiding voor (para)medici' (Dutch) and 'Explain Pain' (Butler and Moseley, 2013; van Wilgen and Nijs, 2018). A waiver was obtained from the medical ethics committee at the University Medical Center of Groningen (UMCG), indicating that formal ethical approval was not needed within the Dutch regulations (number M18.241,418). All participants provided digital written informed consent before the start of the survey. Study design and reporting was based upon the COSMIN (Mokkink et al., 2010a, 2014).

2.2.2. Measures

2.2.2.1. Primary measure. KNAP. At this phase, KNAP contains 34 items, and each scored on a six-point Likert scale to indicate the extent to which they agree with the statement; 1. completely disagree, 2. to a large extent disagree, 3. somewhat disagree, 4. somewhat agree, 5. to a large extent agree and 6. completely agree. The total score can range from 34 to 204 points. A higher score indicates knowledge and attitudes better reflecting modern pain neuroscience. Examples of statements are; 'Pain sensitivity can persist, even if there is no longer an injury or tissue damage, 'Unexplained pain is not real pain', 'Exercise is a good treatment option in persistent pain', 'Correcting poor posture reduces persistent pain'. See appendix 1 for the full version of the Dutch KNAP and appendix 2 for the English KNAP and its scoring method.

2.2.2.2. Secondary measures. Sociodemographic items of the participants included; gender, age, achieved level of education before entering the physiotherapy education program, and personal experiences with persistent pain.

PABS-PT. A 14 items Rasch modified version of the PABS-PT was used, of which seven items belong to the biomedical subscale (subscale scores range from 7 to 40) and seven items to the biopsychosocial subscale (subscale scores range from 7 to 32) (Eland et al., 2016). Higher scores on a subscale indicates a stronger orientation. The PABS-PT showed 'fair' methodological quality scores on the COSMIN criteria (Mutsaers et al., 2012; Eland et al., 2016). The internal consistency for the biopsychosocial subscale was Cronbach's $\alpha = 0.62$–0.68 and for the biomedical subscale Cronbach's $\alpha = 0.77$–0.84. Test-retest reliability of the biomedical subscale was ICC = 0.81 and of the biopsychosocial subscale ICC = 0.65 (Mutsaers et al., 2012).

NPQ. NPQ contains 12 items relating to the neurophysiology of pain (revised 12-item rNPQ) (Catley et al., 2013). The total score ranges from 0 to 12, with higher scores indicating more correct responses. The Dutch NPQ contains an acceptable level of reliability (ICC 0.76) and internal consistency (Chronbach's $\alpha = 0.77$) for evaluating the knowledge of the neurophysiology of pain in patients with chronic fatigue syndrome (Meeus et al., 2010).

A single statement was added as anchor after studying PNE course (T2), to assess how much change in knowledge and attitudes since the baseline measurement was experienced by the participant himself (Van Kampen et al., 2013; de Vet et al., 2006; Revicki et al., 2008). The statement was: 'after studying pain education I have..': 1) not improved on knowledge and attitudes of pain, 2) somewhat improved on knowledge and attitudes of pain, but not important, 3) improved on knowledge and attitudes of pain and 4) greatly improved on knowledge and attitudes of pain.

2.2.2.3. Data collection. After the explanation of the purpose and procedure by the authors (RR or AB), the students completed the survey digitally during regular class. The students were supervised to guarantee results represent individual student responses. Anonymity was guaranteed, and participation was voluntary. The survey consisted of three questionnaires and demographics. The order of the questionnaires was randomly assigned at the level of the individual. Participants were able to correct answers on previous pages by use of a "back" button; however, they were prevented from reentering the survey after they had ticked the "Finish" button. E-mail invitations were sent shortly before the start of the class. The survey was left open for one week after class for those students who did not participate during class. A reminder was sent one week after the first response. The procedure for the retest was identical. The average completion time was 12 min for all three questionnaires.

2.2.2.4. Data analysis. Missing data were examined in the data files. Participants were excluded from analysis if one of the three questionnaires as a whole was not filled in. We performed a multiple imputation procedure on missing values (using five imputations) (Taylor and Rubin, 2012). All items were examined for normality. The demographic data were described by means and standard deviations (SD). Statistical analysis was performed utilising the IBM Statistical Package for Social Sciences (SPSS) version 24.0 (SPSS Inc, Chicago, IL). The interval Rasch model was analysed using Winsteps software (v4.0.03) (www.winsteps.com). To examine the measurement properties of KNAP; internal consistency, test-retest reliability, measurement error, smallest detectable difference (SDD), structural validity, hypotheses testing, items in Rasch analysis, responsiveness and interpretability was analysed (Mokkink et al., 2010b, 2014).

Internal consistency was assessed by calculation of Cronbach's α of items included in each factor in the Exploratory Factor Analysis (EFA). Alpha values were considered adequate when >0.70 and < 0.95 (Terwee et al., 2007). Item–total correlations should be > 0.20, and items with lower correlations were discarded (Streiner et al., 2015). Test-retest reliability was evaluated via intraclass correlation coefficients (ICC (2,1)). ICC of >0.75 was considered adequate (Portney and Watkins, 2000). Measurement error was analysed by calculating the Standard Error of Measurement (SEM= $SD\sqrt{1\text{-}ICC}$) (Weir, 2005). Smallest detectable difference (SDD) was calculated as $1.96x\sqrt{2}xSEM$ (Van Kampen et al., 2013; Terwee et al., 2009). Because the SDD is sensitive to outliers, iterative outlier removal with two iterations were performed when the difference was >3xSD (99%) (Parrinello et al., 2016). Data from T0 and T1, with a two weeks' interval were used to determine ICC, SEM, and SDD.

Structural validity was analysed using Exploratory Factor Analysis (EFA) to guide future hypotheses, reveal patterns within the data set, and to identify a candidate set of items for Rasch analysis. All 34 KNAP items were subjected to EFA. To analyse whether factor analysis was appropriate, the Kaiser–Meyer–Olkin (KMO) coefficient should be ≥ 0.60, and the Bartlett test of Sphericity significant ($p < 0.05$). Furthermore, varimax rotation with Kaiser Normalization (3 iterations) was used. The number of factors extracted was based on the scree plot, the item loading on the different factors and the eigenvalue >1 (Kaiser's criterion) (Field, 2013). Items with a factor loading of <0.30 and negative effect on Cronbach's α were considered for removal. Additionally, floor or ceiling effects were existent if >15% of KNAP scores are within the highest or lowest scores (Terwee et al., 2007).

Hypotheses testing was applied to test the construct validity. Four a priori hypotheses were tested. Support for convergent validity was assumed when correlations between the KNAP and PABS-PS was $r > 0.40$ and with NPQ $r > 0.50$. Support for divergent validity was assumed when correlations between the KNAP and the PABS-BM was $r < -0.40$. A hypothesised increase of KNAP-scores from year 1 to year 4 was tested using a one-way ANOVA with Bonferroni corrected post hoc comparisons. Support of construct validity was assumed when 3 out of 4 (75%) of the hypotheses were accepted.

Rasch analysis was performed to test the presumptions of the Rasch model, including local independency and unidimensionality (Pallant and Tennant, 2007). We examined the item difficulty; items were considered too easy if over 95% of persons answered correctly and too hard if under 5% were answered correctly. The overall fit of data to the model and potential misfit was further explored, and items were considered for removal if fit residuals were beyond standardised ±2.5 (99%CI) or if fit statistics were >1.3 (model underfit) or <0.7 (model overfit) (Fox and Jones, 1998). A Person Separation Index (PSI) value of >0.8 in Winsteps implies the scale is sensitive enough to distinguish between individuals with high and low agreeability, suggesting a good reliability (Linacre, 2012). The assumption of local dependence should be < 0.70. To assess the function of the Likert-type scale categories, the category order was assessed on a per-item level (partial credit model). Category collapsing was considered to improve the fit of the items. Items were reviewed and considered for removal if they had excessive fit statistics and breeched the assumption of local independence. After fit to the Rasch model was achieved, a transformation of ordinal raw scores to interval scaled measures was obtained by producing transformation tables (Grimby et al., 2012; Espejo, 2004). For further psychometric testing, Rasch transformed measures were used.

Responsiveness was defined as the ability of the KNAP to detect change over time in knowledge and attitudes of pain after studying PNE. The Minimal Important Change (MIC) was defined as the smallest measured change score that is deemed important (Terwee et al., 2007; Vet et al., 2011). MIC was measured by using an anchor-based mean change technique (crude method) (Hays et al., 2005). For each category of the anchor question, the MIC is calculated. Category 1: no improvement on knowledge and attitudes of pain after PNE, Category 2: somewhat improvement on knowledge and attitudes of pain, but not important, Category 3: improvement on knowledge and attitudes of pain and Category 4: great improvement on knowledge and attitudes of pain. Interpretability was defined as the degree to which one can assign qualitative meaning to change in scores (Terwee et al., 2007; Rousson, 2013). Interpreting change in KNAP-scores requires two benchmarks: the SDD and MIC. For the interpretability of change scores on KNAP, mean changes and 90%CI were calculated in a study sample who attended pain education. A positive rating for interpretability was assumed when KNAP change scores are > SDD, and if SDD < MIC (Terwee et al., 2007).

3. Results

3.1. Phase I – development

Step 1; resulted in a preliminary 30 item KNAP. Step 2; 9 items considered relevant in the context of knowledge and attitudes of pain were added, resulting in a 39 item KNAP, grouped into 2 domains: (a) pain physiology and influencing factors and (b) treatment of pain. Step 3; after expert review procedure, the number of items was reduced to 34. Step 4; no change in the number of items. After testing measurement properties, including Rasch analysis, items were reduced to 30 (Fig. 1).

3.2. Phase II - measurement properties

3.2.1. Study sample

Surveys were sent to 863 physiotherapy students. In total 473 participants responded, 49 were excluded from analysis due to missing one of the questionnaires. Of the overall questionnaire data, 0,87% was

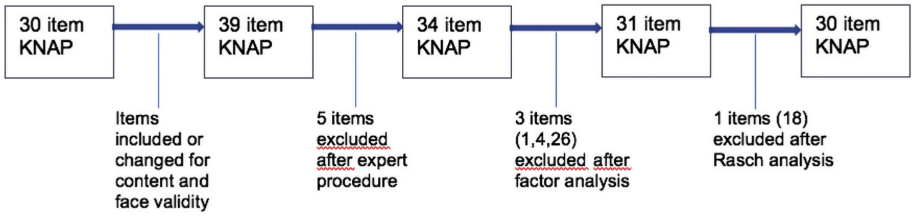

Fig. 1. Number of KNAP items.
KNAP; Knowledge and attitudes of pain.

missing. The final analysis included 424 participants for structural validity (response rate of 55%) (T0). For the test-retest and SDD analyses, we included 156 participants, who completed the questionnaires at both T0 and T1. For the MIC analyses, we included 76 participants who completed PNE (T2). Nearly half (47%) of the students had experienced persistent pain and had been treated for persistent pain. Results did not differ between participants with and without persistent pain experience. Table 1 shows the characteristics of the study participants.

3.2.2. Reliability

The EFA yielded two factors. Cronbach's α coefficients for the two factors were 0.78 and 0.63. Removal of items number 1, 4 and 26 resulted in Cronbach's α 0.78 and 0.71 (Appendix 3). The overall internal reliability was Cronbach's α 0.80. All α values reached the 0.7 cut-off suggesting adequate internal reliability of the two factors (Mokkink et al., 2010b). Test-retest reliability was: ICC 0.80 (95% CI: 0.74; 0.85), the SEM was 2.1 and the SDD90% was 4.99 (4.31; 5.75).

3.2.3. Structural validity

The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis KMO = 0.80, including all 34 items. Item 1 (F1: 0.196, F2: 0.224), item 4 (F1: 0.050, F2: 0.234) and item 26 (F1: 0.128, F2: 0.251) were removed, resulting in a KMO of 0.857. Bartlett's test of Sphericity was $p < .001$. Two components had eigenvalues over Kaiser's criterion of 1. After the removal of items, the components combined explained 28.4% of the variance, and <15% of participants achieved the lowest or highest possible scores, indicating an absence of floor and ceiling effects (Appendix 3).

Table 2
Minimal Important Change (MIC) on knowledge and attitudes of pain.

Category	n (%)	MIC (n = 76)
1: not improved	0 (0.0)	–
2: somewhat improved but not important	5 (6.6)	2.00 (95%CI -7.22; 11.22)
3: improved	38 (50.0)	4.84 (95%CI 2.77; 6.91)
4: greatly improved	33 (43.4)	7.53 (95%CI 5.57; 9.47)

MIC: Minimal Important Change, n: sample size, CI: Confidence Interval.

3.2.4. Hypotheses testing

Correlation between KNAP and PABS-PT biopsychosocial subscale was: r = 0.60 (95%CI 0.54; 0.66), between KNAP and NPQ was r = 0.52 (95%CI 0.45; 0.58) and between KNAP and PABS-PT biomedical subscale r = −0.58 (95%CI -0.63; −0.53). Differences between year 1 and year 4 were significant ($F = 63.92$, $p \leq .001$, $\eta^2_p = 0.313$), post hoc analysis showed a difference between year 1 and 4 of 8.70 (95%CI 6.98; 10.43) ($p \leq .001$). No hypotheses were rejected, thereby supporting construct validity.

Rasch analyses showed that the item difficulty was adequate. Items 18 and 9 showed an excessive positive infit (2.04 resp.1.59) to the Rasch model. Items 18 and 9 showed an excessive positive outfit (2.11 resp.1.63). Item 18 was removed because an excessive outfit maintained after response category collapse. No item breached the assumption of local independence. The person reliability was α 0.82 (modest), and the item reliability was α 0.99 (strong). The PSI was 2.15 (good) (Duncan et al., 2003). The item separation index was 11.82 (desirable) (Linacre, 2012). For 19 of 31 items categories were recoded in 6 ways of collapsing (Appendix 4). For the transformation table, see appendix 5.

Table 1
Characteristics of participants across the 3 samples.

Sample (measurement properties)	Cross sectional/T0 (internal consistency, construct validity, Rasch analysis) (n = 424)	Test-retest/T1 (ICC, SDD) (n = 156)	PNE/T2 (MIC) (n = 76)
Male, n (%)	155 (36.6)	57 (36.5)	30 (39.5)
Age (years): mean (SD)	20.52 (2.3)	20.0 (2.5)	22.0 (20.5–23.0)[a]
Completed education level, n (%):			
High school	296 (69.8)	107 (68.5)	41 (54.0)
Associate's degree (EQF 4)	91 (21.5)	36 (23.1)	24 (31.6)
Bachelor's degree (EQF 6/hbo)	18 (4.2)	8 (5.1)	7 (9.2)
Bachelor's degree (EQF 6/wo)	16 (3.8)	3 (1.9)	4 (5.3)
Other	3 (0.7)	2 (1.3)	–
Experiencing persistent pain, n (%)	200 (47.2)	86 (55.1)	26 (34.2)
Treated for persistent pain n (%)			
At the moment	32 (7.5)	14(9.0)	8 (10.5)
In the past	202 (47.6)	79 (50.6)	30 (39.5)
Having family or friends with persistent pain n (%)	278 (65.6)	105 (67.3)	49 (64.5)
Knowing persons who work with people with persistent pain n (%)	158 (37.3)	60 (38.5)	34 (44.7)

ICC: intraclass correlation coefficients, SDD: smallest detectable difference, PNE: Pain Neuroscience education, MIC: Minimal Important Change; n: sample size; SD: standard deviation; [a]: median, IQR: interquartile range, EFQ: European Qualifications Framework (Nuffic, 2019), WO; Wetenschappelijk Onderwijs (Dutch), HBO; Hoger Beroeps Onderwijs (Dutch).

3.2.5. Responsiveness and interpretability

On group level, 93% improved on KNAP after studying PNE, 43% improved at or above the SDD and at or above the MIC. For category 3 ‘improved’, the MIC is 4.84 (95%CI: 2.77; 6.91) and slightly below the SDD90%: 4.99 (4.31; 5.75). For category 4 ′greatly improved’, the MIC is 7.53 and above the SDD90% (Table 2).

4. Discussion and conclusion

During four phases, a 30-item questionnaire was developed. Overall, extensive testing demonstrated adequate measurement properties. The results do not falsify the hypotheses, suggesting support for the construct validity of KNAP. High values on PSI and person reliability suggest that KNAP has sufficient sensitivity to differentiate between respondents consistently. Local dependence (<0.7) suggests that all items are needed for measurement. After fit to the Rasch model, a transformation of ordinal raw scores to interval scaling was achieved, so that the rating scale did fully maximise the measurement potential, which was supported by the absence of floor or ceiling effects.

The results show that KNAP is responsive to detect clinically relevant changes in knowledge and attitudes of pain after completion of a course focusing on PNE. The MIC of 4.84 is considered a meaningful change in a sample of physiotherapy students. The MIC represents the magnitude of change perceived to be beneficial in the context of educational interventions intended to influence future HCPs’ knowledge and attitudes of pain. This would aid the interpretation of studies investigating educational interventions using these types of instruments as outcome measures (O’Sullivan et al., 2013).

Higher KNAP score means that knowledge and attitudes of pain are more congruent with modern pain neuroscience. Because knowledge and attitudes of pain evolves, we need to evaluate the KNAP on a regular basis on current pain knowledge. The content validity of the KNAP should be updated repeatedly. Whether the effect sizes of the educational intervention are large enough to determine changed clinical practice and patient-related outcomes is unknown at present and should be subject for further research (Shuval et al., 2007; Stevenson et al., 2006; Adillón et al., 2015; Kennedy et al., 2014). Effect of educational interventions should be tested by adding outcome measures on the level of practice behaviour, and ultimately on relevant patient-related outcomes (Lakke et al., 2015; Mutsaers et al., 2012; Overmeer et al., 2009). In the traditional biomedical model, pain relief is perceived to be needed to improve physical functioning, which can be a barrier for optimal management of pain (Gardner et al., 2017; Sullivan, 2011; Foster et al., 2003). Patients indicated that they learned negative biomedical beliefs from HCPs (Darlow et al., 2012; Setchell et al., 2017). Contrary to current “best practice” guidelines for LBP management, a potential consequence of such beliefs is avoidance of physical activities, which is likely to result in increased morbidity. Providing this new instrument for assessing knowledge and attitudes to create awareness towards (persistent) pain in HCPs aims to identify and positively influence patient beliefs which may decrease the threat associated with MSK pain (Darlow, 2016; Poitras et al., 2012). Also, awareness can help to design better education programs that could improve persistent pain prevention, more effective implementation of existing guidelines and new treatment models (Poitras et al., 2012; Hush et al., 2018).

The present study has several strengths, including a robust and extensive procedure for developing and testing measurement properties of KNAP using both classic and Rasch methods, more robust and extensive than similar questionnaires. The large sample size (>400 participants) was sufficient for testing structural validity and minimised participation bias. The MIC of the present study must be interpreted with caution since we could not make use of the ROC-technique (Receiver Operating Characteristic), due to a too low amount of non-positive changing participants. Consequently, parameters as the AUC (Area Under Curve), sensitivity and specificity are missing, which limits unbiased discriminating between improved and unchanged respondents (Terwee et al., 2010). Reporting a SDD of 90% means the test is more sensitive in detecting (relevant) changes in knowledge and attitudes compared to a SDD of 95%, considering the consequence of more false-positives in this case as not harmful. All participants had almost the same age and socioeconomic profiles, which are typical for the target population. They stem from the same geographic areas of the Netherlands, the relevance of which is unknown, but probably low. The findings provide a basis to investigate differences and develop reference values of knowledge and attitudes scores using other samples of HCPs and the general public (Chalmers and Madden, 2019). This study aimed to develop and validate KNAP in future HCPs. A future step will be to validate the KNAP in HCPs, which should be done in HCPs with different years of working experience.

Results of repeated measurements of the KNAP may be influenced by recall bias. To prevent recall bias, the time interval should be long enough. A time interval of about two weeks is often considered appropriate (Streiner, 2008), also applied in this study. It has to be noted that the KNAP is less useful as an exam to test the comprehensive body of knowledge of pain repeatedly. For this purpose alternative forms of knowledge tests would be recommended. The Dutch KNAP has been submitted to a small sample of the target group a priori to testing the psychometric properties, which could have affect the feasibility and the content validity. The magnitude of correlation between instruments may suggest acceptable convergent validity, but given the absence of good measurement properties of the PABS-PT and NPQ, the findings needed to be interpreted with caution (Mutsaers et al., 2012; Catley et al., 2013).

In conclusion: The KNAP has adequate measurement properties to evaluate future HCPs’ knowledge and attitudes of modern pain neuroscience. This new questionnaire could be useful to evaluate future HCPs’ knowledge and attitudes that could help to design awareness and education activities and ultimately provide better pain management. It requires further study on active HCPs to get insight into the implicit attitudes and their influence on actual practitioner behaviours during clinical practice and ultimately on intervention outcomes.

Ethical approval

Written consent was obtained from all participants.

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Declaration of competing interest

None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.msksp.2020.102236.

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