Development and validation of a short-form Pain Medication Attitudes Questionnaire (PMAQ-14)

James Elander, Omimah Said, Frances A. Maratos,
Ada Dys, Hannah Collins, and Malcolm B. Schofield

University of Derby, UK

Correspondence: James Elander, Centre for Psychological Research, University of Derby, Kedleston Road, Derby DE22 1GB, UK. Email j.elander@derby.ac.uk

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ABSTRACT

Attitudes to pain medication are important aspects of adjustment to chronic pain. They are measured by the 47-item Pain Medication Attitudes Questionnaire (PMAQ). To measure those attitudes more quickly and easily, we developed and evaluated a 14-item PMAQ using data from three separate surveys of people with pain in the general population. In survey 1, participants (n=295) completed the 47-item PMAQ and measures of pain, analgesic use, analgesic dependence and attitudes to self-medication. For each of the seven PMAQ scales, the two items that best preserved the content of the parent scales were identified using correlation and regression. The 2-item and parent scales had very similar relationships with other measures, indicating validity had been maintained. The resulting 14-item PMAQ was then completed by participants in survey 2 (n=241) and survey 3 (n=147), along with the same other measures as in survey 1. Confirmatory factor analysis showed that the 14-item PMAQ retained the 7-factor structure of the 47-item version, and correlations with other measures showed it retained the validity of the 47-item version. The PMAQ scale Need was the most significant independent predictor of analgesic dependence in each of four separate multiple regression analyses. This short form of the PMAQ allows attitudes to pain medications to be measured in a valid and more efficient way.

Keywords: Pain medication; analgesics; attitudes; beliefs; concerns; brief scales; validation.

1. Introduction

The Pain Medication Attitudes Questionnaire (PMAQ) is a 47-item self-report measure with seven scales covering areas of concern for users of pain medications: Addiction, Need, Scrutiny, Side-effects, Tolerance, Mistrust of Doctors, and Withdrawal [24]. The scales had good internal reliability, and Need, Tolerance and Withdrawal were associated with greater pain intensity and greater use of prescribed medications among pain clinic patients [24]. Tolerance, Need and Side-effects were independently associated with depression, mental quality of life and disability among pain clinic patients, suggesting that concerns about pain medication may add to the burden of chronic pain [24,34]. Need was independently associated with analgesic overuse among pain clinic and headache clinic patients, suggesting that patients' concerns may accurately reflect possible reasons for pain medication overuse [22,24,29].

Many patients taking prescribed analgesics are seen in primary care practices where brief tools can be useful, and one study concluded that training general practitioners to identify and address the concerns represented by PMAQ scales could help to improve doctor-patient relationships and increase medication adherence [29]. However, non-prescribed analgesics, including both opiates and non-opiates, are also associated with misuse, abuse and dependence [12], and problematic analgesic use is increasing in many countries among the general population, not just those in clinical contact [3,4,23]. Measures of attitudes and beliefs that can influence analgesic use should therefore be developed and validated for use with general population as well as clinical samples of analgesic users.

With 47 items, the PMAQ is long and time consuming to complete, especially for studies with multiple measures. Shorter questionnaires improve response rates and are recommended for follow-up measures [6,25]. The purpose of the present study was to produce a briefer, 14-item PMAQ, and assess its factor structure and validity. To assess validity, we used the Leeds Dependence Questionnaire (LDQ), which measures the graded severity of psychological dependence [26], and the Self-Medicating Scale (SMS), which measures 'Reluctance' (belief in self-medicating only when symptoms are severe), 'Don't think twice' (belief in not hesitating to self-medicate), and 'Run its course' (belief in letting the body deal with ailments rather than taking medication) [18].

Based on previous findings with the 47-item PMAQ [22,24,29], we predicted that:

1. Need, Tolerance and Withdrawal would be correlated with greater pain intensity and more frequent use of analgesics; and
2. Need would be correlated with analgesic overuse.

Because of the semantic similarity between certain PMAQ subscales and symptoms of substance dependence, we predicted that:

3. Addiction, Need, Tolerance and Withdrawal would be correlated positively with LDQ scores.

Because PMAQ scores associated with more frequent use and overuse of analgesics would also be expected to be associated with more positive attitudes to self-mediation, we predicted that:

4. Need, Tolerance and Withdrawal would be correlated positively with 'Don't think twice' and negatively with 'Reluctance' and 'Run its course'.

2. Methods

2.1. Overview of methods

We selected two items per PMAQ scale using a method that maximizes content validity [19] and then administered the 14-item version to independent samples to test its factor structure and criterion-related validity, following recommendations for short-form scale development [32]. The data were collected in three separate general population surveys conducted primarily for research on social, cultural and emotional influences on analgesic use and dependence. Data from survey 1, in which participants completed the 47-item PMAQ, were used to identify two items per scale and compare 2-item and parent scales. Data from surveys 2 and 3, in which participants completed the 14-item version, were used to assess factor structure and criterion-related validity.

The surveys were all web-based general population surveys. Evidence supports the use of the internet for sampling as well as collecting data [27], and studies using the internet to recruit participants as well as collect data have contributed usefully to research on chronic pain [7,13]. A specific comparison between internet-based and paper-based questionnaires in medical research found no differences in reliability and validity, concluding that, "instruments administered via the Internet appear to be reliable, and to be answered similarly to the way they are answered when they are administered via traditional mailed paper questionnaires" [28, p. 1].

2.2. Participants

The participants were members of the general population who had pain and used analgesics in the previous month (n=295 in survey 1, n=241 in survey 2, and n=147 in survey 3; total n=683). The surveys were open to people with different types of pain, including chronic pain and episodic pain, such as episodic headaches, and also to users of different types of analgesic, including prescribed and non-prescribed opiate and non-opiate analgesics.

The inclusion criteria were: being at least 18 years old; having pain in the last month; using analgesics in the last month; and living in the countries designated for the surveys (UK for surveys 1 and 3; USA, Canada and Australia for survey 2). The exclusion criteria were: not reading English well enough to complete a questionnaire; being less than 18 years old; not having pain and using analgesics in the last month; and not being a resident of the target countries for each survey.

2.3. Measures

Participants indicated how long they had experienced pain and how many days they had pain in the last month. They rated their pain intensity 'at its worst', 'at its least', 'on average' and 'right now', with four 11-point scales ranging from 'no pain' (0) to 'pain as bad as you can imagine' (10)**.** The mean of the four ratings was the measure of pain intensity [5].

Participants also indicated how many days they used analgesics in the last month; whether they used prescribed or over-the-counter analgesics, or both; and whether they 'never' (0), 'sometimes' (1), 'usually' (2) or 'always' (3) used analgesics for longer than recommended and at higher doses than recommended. The mean of the ratings for using analgesics for longer and at higher doses than recommended was the measure of analgesic overuse, which was computed in a similar way as in previous research [29] and provides a graded measure suitable for correlational analyses. Analgesic overuse was also computed categorically, to show the proportions of participants who reported at least sometimes either taking analgesics for longer or at higher doses than recommended. Neither of those measures implies analgesic abuse, dependence or a substance

use disorder, for people can sometimes appear to overuse analgesics if they have more significant pathology or their pain is undertreated [8].

Participants also completed the Pain Medication Attitudes Questionnaire (PMAQ) and the Leeds Dependence Questionnaire. The PMAQ is a 47-item self-report measure with each item rated on a 6-point scale from 'never true' (0) to 'always true' (5). Scale scores are computed as means across items making up seven scales: Addiction, Need, Scrutiny, Side-effects, Tolerance, Mistrust of Doctors, and Withdrawal [24]. Internal reliability was good, with Alpha coefficients from 0.77 to 0.85 [24], and validity was supported by predictable relationships with measures of analgesic use, depression and disability [22,24,29,34]. Participants in survey 1 completed the 47-item PMAQ and those in surveys 2 and 3 completed a 14-item version.

The Leeds Dependence Questionnaire (LDQ) is a brief self-report measure of the graded severity of substance dependence [26]. There are 10 items with 4-point response scales labelled 'never' (0), 'sometimes' (1), 'often' (2) and 'nearly always' (3). The items are based on ICD-10 and DSM-IV criteria for substance dependence: preoccupation, salience, compulsion to start, planning, maximizing effect, narrowing of repertoire, compulsion to continue, primacy of effect, constancy of state, and cognitive set. A single score is computed as the total across the 10 items. The scale had good internal consistency, test-retest reliability, and validity [26]. The original scale asks respondents to nominate their drug of concern and the items refer to 'drink or drugs'. We used a version previously adapted to measure analgesic dependence in which the words 'drink or drugs' in each item are replaced with 'painkillers' (eg., 'do you find yourself thinking about when you will next be able to take painkillers?') [7].

Participants in surveys 1 and 2 also completed the Self-Medicating Scale (SMS), a 9-item measure of beliefs about self-medication [18]. Each item is rated on a 5-point scale from 'strongly agree' (1) to 'strongly disagree' (5). There are three scales: 'Reluctance', 'Don't think twice' and 'Run its course', for which scores are calculated by summing across items. The scales had good internal reliability and their validity was supported by associations with other measures of analgesic use [18].

2.4. Procedure

The study protocols for all three surveys were approved by the University of Derby Psychology Research Ethics Committee. Surveys 1 and 3 were restricted to English speaking UK residents. Survey 2 was restricted to English speaking residents of the USA, Canada and Australia. For each survey, participants were recruited by posting a brief invitation message on specifically relevant online discussion forums and internet websites, eg http://painsupport.co.uk. The invitation message contained a link to the online survey, the first page of which gave further information about the study, including the inclusion criteria and the basis for consent, which participants confirmed before proceeding to the survey itself. In recognition of the time and effort involved in taking part, participants were offered entry to a prize draw for a gift voucher worth £70 (survey 1) or £50 (surveys 2 and 3). Prize draws for values like these are very commonly used in online surveys [11] and there is evidence that they increase response rates without affecting response quality or sample composition [30].

There was at least six months between the data collection for each survey, to maximize the distinctiveness of each survey and reduce the chance that any participant would take part in more than one. We conducted a data audit and screening exercise before the data were analyzed, to review participants' descriptions of their medical conditions and the analgesics they reported using, to ensure that each described a genuine case. The surveys were all anonymous, but each participant

had a unique identifying code, and these were compared between surveys to ensure no individuals participated in more than one survey.

2.5. Analytic approach

Survey 1 data were used to select two items for each of the seven PMAQ scales, following a method using regression analysis that maximizes the content validity of a 2-item scale [19]. The first item selected was the one with the highest correlation with the parent scale. The second item selected was the one with the highest Beta weight of the remaining items in multiple regression with the parent scale score as the dependent variable and individual items as predictor variables. The first item selected was entered in step 1 of the regression, and the remaining items in step 2. The two items were then reviewed qualitatively by JE and OS to ensure they covered the content of the original scale.

Confirmatory factor analyses were then conducted using data from surveys 2 and 3, in which participants completed the 14-item version of the PMAQ. These analyses tested the fit of 7-factor models with two items per factor, by comparison with 1-factor models. Each data set was first analyzed for normality using the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. The Maximum Likelihood estimator method was adopted. For data scaling, the first variable for each scale was set at one. Five indicators of model fit were computed for each model.

Scale scores were then computed and correlations with the criterion measures were tested using data from all three surveys. Because each correlation was tested four times (using parent and 2-item scores in survey 1, and 2-item scores in surveys 2 and 3), we adjusted the critical value of p to 0.0125 (0.05 divided by 4).

3. Results

Participant details are given in Table 1. Females predominated in all three surveys. Very small proportions of survey 1 and 2 participants were members of minority ethnic groups (ethnicity was not recorded in survey 3). Participants with higher education (university or degree-level qualifications) comprised about half of the participants in surveys 1 and 3, and about two-thirds of those in survey 2.

Participants in surveys 1 and 2 were predominantly married or cohabiting, with diagnosed medical conditions, and most had pain for longer than one year and took prescribed analgesics. Participants in survey 3 were younger on average and predominantly single, with fewer diagnosed medical conditions, and most had pain for less than a year, and took non-prescribed analgesics. In all three surveys, those with pain for over a year included many who reported pain for over five, ten and even 20 years.

The most common types of pain were headaches, back pain, joint pain, muscle pain and period pain. The most common diagnosed medical conditions were fibromyalgia, endometriosis, spinal/disc disorders, arthritis, and migraine/headache disorders. The most commonly used analgesics included strong opiates such as morphine, fentanyl and tramadol; weaker opiates such as dihydrocodeine and codeine-based compounds such as co-codamol; and non-opiates, mainly non-steroidal anti-inflammatory drugs such as naproxen, diclofenac and ibuprofen.

Table 1
Participant demographic and clinical characteristics.

	Survey 1	Survey 2	Survey 3
N	295	241	147
Mean age (SD, range)	41.17 (12.3, 19-79)	46.9 (12.5, 19-80)	29.7 (11.7, 18-64)
Female	255 (86.4%)	197 (81.7%)	119 (81.0%)
Minority ethnic group[a]	14 (4.75%)	15 (6.22%)	-
Higher education[b]	149 (50.5%)	158 (65.6%)	79 (53.7%)
Married/cohabiting	197 (66.8%)	177 (73.4%)	47 (32.0%)
Diagnosed medical condition	254 (86.1%)	224 (92.9%)	49 (33.3%)
Pain longer than one year	259 (87.8%)	215 (89.2)	60 (40.8%)
Prescribed pain medication	239 (81.1%)	214 (88.8%)	63 (42.9%)
Overused analgesics[c]	129 (43.7%)	95 (39.4%)	55 (37.4%)

Notes to table 1:
a All groups other than 'White British' (survey 1) or 'White Australian/American/Canadian' (survey 2) (ethnicity was not recorded in survey 3).
b University or degree-level qualifications.
c At least sometimes used more analgesics than recommended or used analgesics for longer than recommended.

3.1. Item selection

The items selected for each scale were as follows (the item with the highest correlation with the parent scale is given first, then the one with the highest Beta weight in step 2 of the multiple regression analyses): Addiction, items 15 and 8; Need, items 42 and 16; Scrutiny, items 37 and 31; Side effects, items 25 and 38; Tolerance, items 12 and 19; Mistrust of Doctors, items 45 and 40; Withdrawal, items 21 and 14. The qualitative review of each pair of items revealed no cases where other items needed to be considered in place of those initially selected. These 14 items were then presented to participants in surveys 2 and 3 in the form given in the appendix.

Table 2
KMO, Bartlett's test and r^2 values for confirmatory factor analyses.

	KMO	Bartlett's test of sphericity			r^2 lowest Value
		*X*2	*df*	*p*	
Survey 2	0.73	1226.22	91	<.001	0.23 (item 8)
Survey 3	0.89	1311.87	91	<.001	0.28 (item 1)

Note to table 2: KMO=Kaiser-Meyer-Olkin.

3.2. Confirmatory factor analysis (CFA)

PMAQ data from surveys 2 and 3 were first analyzed for normality using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity (Table 2). Minimum sample size for confirmatory factor analysis is between 100 and 200 [21], so both samples were large enough to analyze, and the KMO indices showed that sampling adequacy was 'middling' to 'meritorious' [9,16]. Bartlett's test of sphericity was highly significant in both cases, indicating that the correlation matrix was highly factorable.

Table 3 shows values of five fit indices along with the values these should be at least 'close to' for a good fit between model and data [15]. While X^2 was significant in each case, indicating differences between the data and the model, X^2 is known to be over-sensitive to sample size [14], so

that even modest sample sizes can lead to misleadingly significant values, wrongly indicating that a model should be rejected [17]. More informatively, X^2 was over six times larger for the 1-factor model than the 7-factor model in survey 2, and over three times larger in survey 3, showing that the 7-factor model was a much better fit to the data than the 1-factor model.

Table 3
Fit indices and recommended values.

	Survey 2		Survey 3		Recommended values [15]
Fit indices	7-factor	1-factor	7-factor	1-factor	
X^2	106.94	677.86	121.24	396.79	N/A
df	56	77	56	77	N/A
p	<.001	<.001	<.001	<.001	>.05
RMSEA	0.06	0.18	0.09	0.17	<= 0.06
SRMR	0.04	0.13	0.05	0.11	<= 0.08
CFI	0.96	0.49	0.95	0.75	>=0.95
TLI	0.93	0.39	0.92	0.71	>=0.95
NFI	0.92	0.46	0.91	0.71	>=0.95

Notes to table 3: X^2=Chi Squared; *df*=degrees of freedom; *p*=probability; RMSEA=root mean squared error of approximation; SRMR=standardized root mean squared residual; CFI=Comparative Fit Index; TLI=Tucker-Lewis Index; NFI=Normed Fit Index.

In survey 2, the fit indices for the 7-factor models were the correct side of the recommended values for three of the indices (RMSEA, SRMR and CFI), and very close for the remaining two. In survey 3, they were the correct side for two indices (SRMR and CFI) and very close for the remaining three. These indicate a good fit between the 7-factor model and both the survey 2 and 3 data. There were marked differences in fit indices between 1-factor and 7-factor models in both surveys, with the indices for the 1-factor models well outside the recommended values for all five indices in both surveys. These analysis therefore supported a 7-factor structure.

The correlations among standardized residuals were also examined to identify any values greater than 0.2, which would indicate localized areas of strain. None were present, however, indicating no problematic items and no need for scale re-specification.

3.3. Validity of 2-item PMAQ scales

Table 4 shows descriptive statistics for the criterion measures in the three surveys. These show that, compared with participants in surveys 1 and 2, participants in survey 3 had less frequent and less intense pain, used analgesics less frequently, and had lower analgesic dependency scores.

Table 5 shows descriptive statistics for the parent and 2-item PMAQ scales in survey 1, and the 2-item scales in surveys 2 and 3. In both surveys 1 and 2, scores were highest for Need and Tolerance, just as in a previous clinical sample [24]. Cronbach's Alpha coefficients in survey 1 ranged from 0.79 to 0.90 for the parent scales, compared with 0.77 to 0.85 in the previous sample [24]. The correlations between parent and 2-item scales in survey 1 were Addiction 0.95, Need 0.88, Scrutiny 0.80, Side-effects 0.89, Tolerance 0.90, Mistrust of Doctors 0.91, and Withdrawal 0.90, with $p<0.001$ in each case. In survey 3, PMAQ scores were generally lower, except for Mistrust of Doctors, which was the highest mean score.

Table 4

Mean (SD) values for measures in the three surveys.

Measure/scale	Survey 1	Survey 2	Survey 3
Pain frequency (days in last month)	24.22 (9.88)	27.17 (7.28)	12.94 (10.05)
Pain intensity	5.33 (1.88)	5.13 (1.56)	3.02 (1.32)
Analgesic frequency (days in last month)	21.79 (11.44)	24.42 (10.03)	10.01 (10.03)
Analgesic dependency (LDQ)	10.18 (5.75)	8.64 (5.67)	6.52 (5.11)
Self-medicating scale			
Reluctance	11.35 (3.48)	11.04 (3.33)	-
Don't think twice	9.81 (3.32)	9.02 (3.15)	-
Run its course	7.65 (2.97)	7.65 (2.81)	-

Note to table 4: SD=standard deviation; LDQ=Leeds Dependence Questionnaire.

Table 5

Descriptive statistics (mean, SD) for PMAQ scales and Cronbach's Alpha coefficients for parent scales.

Scale	Survey 1 parent		Survey 1 2-item	Survey 2 2-item	Survey 3 2-item
	Mean (SD)	Alpha	Mean (SD)	Mean (SD)	Mean (SD)
Addiction	1.42 (1.32)	0.90	1.53 (1.44)	1.51 (1.27)	1.18 (1.23)
Need	2.43 (1.23)	0.87	2.32 (1.64)	2.45 (1.47)	1.05 (1.41)
Scrutiny	1.46 (1.00)	0.79	1.14 (1.44)	1.61 (1.56)	0.86 (1.33)
Side-effects	1.91 (1.20)	0.85	2.05 (1.36)	2.05 (1.18)	1.17 (1.24)
Tolerance	2.12 (1.33)	0.87	2.25 (1.62)	2.10 (1.35)	1.26 (1.35)
Mistrust	1.95 (1.18)	0.84	2.26 (1.60)	1.77 (1.43)	2.79 (1.65)
Withdrawal	1.70 (1.34)	0.88	1.90 (1.59)	1.62 (1.50)	0.87 (1.26)

Note to table 5: Scale scores are computed as means across items.

T-tests showed that in surveys 1 and 3 there were no significant gender differences for any parent or 2-item scales, but in survey 2 males scored significantly higher than females for Need [male mean=2.99 (SD 1.36); female mean=2.34 (SD 1.48); $t_{(239)}$=2.69, p=0.008] and Withdrawal [male mean=2.08 (SD 1.60); female mean=1.52 (SD 1.47); $t_{(239)}$=2.25, p=0.025].

Table 6 shows correlations between PMAQ scales and the criterion measures. In all four tests, Need, Tolerance and Withdrawal were correlated with pain intensity and analgesic frequency, as predicted in hypothesis 1. However, Tolerance was the only scale correlated with analgesic overuse in all four tests, rather than Need as predicted in hypothesis 2.

In all four tests, Addiction, Need, Tolerance and Withdrawal were correlated with analgesic dependence, as predicted in hypothesis 3. Side-effects was also consistently correlated with analgesic dependence.

In all three tests of the correlations with beliefs about self-medication, Need, Tolerance and Withdrawal were correlated negatively with Reluctance and positively with Don't think twice, and Need and Withdrawal were correlated negatively with Run its course, as predicted in hypothesis 4. However, Tolerance was not consistently correlated with Run its course, as had been predicted. Scrutiny and Mistrust of Doctors were not consistently correlated with any of the criterion measures.

Table 6.

Correlations between PMAQ scales and criterion measures.

	Pain duration	Pain frequency	Pain intensity	Analgesic frequency	Analgesic overuse	Dependence (LDQ)	Reluctance (SMS)	Don't think twice (SMS)	Run its course (SMS)
Addiction FP survey 1	.29**	.27**	.17*	.33**	.15*	.47**	-.19**	.26**	-.17*
Addiction SF survey 1	.26**	.26**	.16*	.29**	.16*	.41**	-.17*	.21**	-.14
Addiction SF survey 2	.02	.04	.02	.05	.16	.32**	-.19*	.17*	-.06
Addiction SF survey 3	.12	.21*	.24*	.28**	.32**	.43**			
Need FP survey 1	.41**	.38**	.41**	.53**	.25**	.72**	-.32**	.39**	-.38**
Need SF survey 1	.31**	.27**	.30**	.41**	.14	.61**	-.36**	.42**	-.40**
Need SF survey 2	.29**	.29**	.26**	.47**	.06	.52**	-.30**	.39**	-.27**
Need SF survey 3	.41**	.45**	.37**	.53**	.44**	.54**			
Scrutiny FP survey 1	.10	.13	.11	.11	.11	.09	-.04	.07	.01
Scrutiny SF survey 1	.16*	.15	.19**	.17*	.15*	.22**	-.03	.03	-.00
Scrutiny SF survey 2	.18*	.03	.08	.11	.18*	.10	-.05	-.01	.10
Scrutiny SF survey 3	.31**	.35**	.33**	.43**	.31**	.37**			
Side-effects FP survey 1	.35**	.29**	.33**	.30**	.08	.47**	-.06	.05	-.05
Side-effects SF survey 1	.30**	.27**	.29**	.28**	.12	.42**	-.09	.06	-.06
Side-effects SF survey 2	.17*	.05	.20*	.05	.17*	.17*	-.12	.06	-.05
Side-effects SF survey 3	.25*	.26**	.25*	.32**	.32**	.34**			
Tolerance FP survey 1	.41**	.42**	.41**	.47**	.22**	.58**	-.16*	.17*	-.14
Tolerance SF survey 1	.37**	.38**	.35**	.46**	.21**	.57**	-.16*	.24**	-.17*
Tolerance SF survey 2	.19*	.15	.22**	.20*	.24**	.45**	-.19*	.27**	-.15
Tolerance SF survey 3	.43**	.38**	.41**	.41**	.38**	.53**			
Mistrust FP survey 1	.02	.01	-.01	-.07	.03	-.05	.05	-.08	.14
Mistrust SF survey 1	-.02	-.05	-.04	-.13	.04	-.13	.09	-.13	.18*
Mistrust SF survey 2	-.06	-.05	.15	-.03	.34**	-.07	.04	-.04	.11
Mistrust SF survey 3	.15	.05	.02	.00	.04	.04			
Withdrawal FP survey 1	.33**	.38**	.36**	.48**	.12	.56**	-.34**	.42**	-.31**
Withdrawal SF survey 1	.33**	.34**	.32**	.47**	.19**	.56**	-.28**	.36**	-.29**
Withdrawal SF survey 2	.16*	.24**	.24**	.37**	.08	.47**	-.35**	.39**	-.22**
Withdrawal SF survey 3	.35**	.38**	.35**	.50**	.45**	.53**			

Notes to table 6: FP=full parent scale; SF=short form (2-item) scale; PMAQ=Pain Medication Attitudes Questionnaire; LDQ=Leeds Dependence Questionnaire; SMS=self-medicating scale.

* $p<0.0125$; ** $p<0.00125$.

Because the associations between PMAQ scales and analgesic dependence were new evidence about influences on analgesic dependence, we examined those relationships further using regression analyses. These were structured in the same hierarchical way as in previous PMAQ research [24,29]. Pain intensity was forced into the regression equation in the first step to control for variance attributable to pain. The seven PMAQ scales were then added stepwise depending on statistical criteria; $p < 0.0125$ to enter (0.05 divided by 4, because there were four analyses); $p > 0.10$ to remove. The results are given in Table 7. The four sets of results were very similar. Need was the most significant independent predictor in all four analyses, and Tolerance was also a significant independent predictor in three of the analyses.

Table 7
Summary of multiple regression analyses predicting analgesic dependence (LDQ score)

Predictors	Step ΔR^2	Final model β	Final model R^2
Survey 1: 47-item PMAQ			
1. Pain intensity	0.13**	0.05	
2. Need	0.40**	0.63**	
3. Side effects	0.03**	0.18**	0.56
Survey 1: 14-item PMAQ			
1. Pain intensity	0.13**	0.12*	
2. Need	0.28**	0.36**	
3. Tolerance	0.06**	0.22**	
4. Withdrawal	0.02*	0.17*	0.49
Survey 2: 14-item PMAQ			
1. Pain intensity	0.04**	0.03	
2. Need	0.23**	0.33**	
3. Tolerance	0.06**	0.20**	
4. Withdrawal	0.03*	0.20*	0.36
Survey 3: 14-item PMAQ			
1. Pain intensity	0.11**	0.10	
2. Need	0.20**	0.32**	
3. Tolerance	0.05*	0.28*	0.35

Notes to table 7: The four regression analyses were all structured hierarchically in the same way. Pain intensity was forced into the equation in the first step. The seven PMAQ scales were then added stepwise depending on statistical criteria ($p< 0.0125$ to enter, $p>0.10$ to remove).
PMAQ=Pain medication attitudes questionnaire; LDQ=Leeds dependence questionnaire.
* $p<0.0125$; ** $p<0.00125$.

4. Discussion

All the correlations between parent and 2-item scales in survey 1 were above 0.80, and four of the seven were above 0.90, with $p<0.001$ in every case. Even allowing for the fact that these coefficients overestimate the correlations between the two forms [32], these very high correlations showed that the parent and 2-item scales produced scores that were very closely related to one another.

The hypothesized correlations between PMAQ scores and criterion measures were also consistent across forms and surveys, with Need, Tolerance and Withdrawal most closely related to pain, analgesic use, analgesic dependence and beliefs about self-medication. This supported the

criterion-related validity of the short-form PMAQ and its use with general population samples of analgesic users. It could therefore be used in large scale national and international surveys to help identify early indicators or risk factors for problematic analgesic use, which is important because analgesic misuse and addiction are increasing internationally [3,4,23].

This is also the first evidence about relationships between PMAQ scores and analgesic dependence. Substance dependence was a diagnostic category in DSM-IV-TR [1], but does not feature in the DSM-5, which gives criteria for 'opioid use disorder' and 'other substance use disorder' (which would apply for non-opiate analgesics) [2]. One reason for the change is recognition of the ambiguous nature of the term 'dependence', and the fact that physiological dependence is not unusual among people taking opioids for pain and should not be treated as indicating addiction or disordered substance use [31]. Tolerance and withdrawal are both included among the criteria for opioid use disorders in DSM-5, but both are "not considered to be met for those taking opioids solely under appropriate medical supervision" [2, p. 541]. However, the 11 DSM-5 criteria for substance use disorder include all seven of the DSM-IV-TR criteria for substance dependence, so aspects of dependence continue to be significant elements of more broadly conceived substance use disorders [1,2]. Also, *psychological* dependence is an established construct that may be an important influence on the development of substance use disorders, and the LDQ is an established measure of psychological dependence that continues to be used with good reliability and validity [10,20].

In the regression analyses, Need and Tolerance were consistent independent predictors of analgesic dependence, but Addiction was not a significant independent predictor at all. Based on item content, Need and Tolerance refer more to physiological aspects of dependence, whereas Addiction refers to more general fears about addiction and becoming an addict. This should be interpreted carefully for, as noted earlier, symptoms of physiological dependence are not unusual among people taking prescribed opiates for chronic pain, and dependence itself is no longer a DSM-5 diagnostic category. These findings suggest that concerns or fears about physiological dependence play a role in people's feelings of dependence on analgesics. Both the PMAQ and LDQ measure subjective aspects of people's analgesic use, so they are more useful for understanding processes in the development of analgesic use disorders than for identifying or diagnosing disorders themselves.

This work is part of a growing trend for shorter self-report instruments that can be used for screening and other purposes, especially with new populations where a priority is to minimize the burden of assessment [33]. By selecting items in a way that maximized content coverage and administering the short form to independent samples, as well as testing the factor structure of the short form and validating it in the form it will be used, we followed recommended steps for short-form scale development [32]. We also adopted a conservative approach to criterion validity testing, with four separate tests of each hypothesized relationship, using critical values of p adjusted for multiple tests.

The data also suggested that the survey 1 and 2 samples were similar to the clinical samples of previous PMAQ studies, with high proportions of married or cohabiting females, long durations of pain, high proportions of prescribed analgesics, and high levels of analgesic overuse [24,29]. In surveys 1 and 2 the highest PMAQ scores were for Need and Tolerance, just as in a previous clinical sample [24], and the range of mean PMAQ scores in surveys 1 and 2 were also within those in the clinical sample, where PMAQ scores ranged from 1.04 to 2.81 [24].

Participants in survey 3 were younger and more likely to be single, compared with participants in surveys 1 and 2, with fewer diagnosed medical conditions and prescribed analgesics, and had less pain, less frequent analgesic use, and less analgesic dependence. They also had lower

PMAQ scores for every scale except Mistrust of Doctors, for which they had higher scores, which might be related to their presumably less frequent and less close contact with doctors. The survey 3 sample probably represents people at an earlier stage in the development of problems with chronic pain and analgesics, with fewer users of strong opiate analgesics, and the validity of the short-form PMAQ in this sample is important because more research is needed on the wider population of analgesic users.

The study does have a number of limitations, however. Notwithstanding the evidence that online participant recruitment and data recruitment are as valid as other methods [27,28], some selection bias is perhaps almost inevitable. The participants in all three surveys consisted mainly of women, and all information about the nature and duration of participants' pain problems and prescribed analgesic use was self-reported, so although we carefully reviewed each case, we cannot ultimately be certain that results would generalize to a typical patient population in a primary care center or pain center. For example, over a third of participants reported some analgesic overuse, but the accuracy of those reports is ultimately uncertain and the study would be strengthened by including urine screen data, provider ratings, objective measures of medication use, or other valid self-report measures of opioid misuse.

Other factors that could potentially be of interest were also not included among the study measures. For example, we measured pain intensity but not pain-related interference [5], which might be related to analgesic use, overuse or dependence. Pain intensity was not a significant independent predictor in the final models of three of the four regression analyses, and it is possible that pain-related interference would be a more informative predictor of analgesic dependence.

Also, many of the PMAQ-14 items address worries and fears, so the relationships between PMAQ scores and pain catastrophizing, anxiety and depression would be of interest. It is possible, for example, that the PMAQ focuses mainly or exclusively on emotional risk factors for pain medication misuse, and leaves out behavioral risks, like past misuse or problem use behaviors.

To conclude, this short form of the PMAQ allows attitudes to pain medications to be measured in a valid and more efficient way, which could allow attitudes to pain medication to be measured in more future studies, for example: studies of analgesic users not in contact with specialist pain clinics; studies focusing on how PMAQ data could inform treatment and prescribing decisions; and longitudinal research to identify influences on changes in analgesic use and dependence. Longitudinal studies like that could inform better early identification of problems and health education initiatives to help people avoid analgesic use disorders.

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Appendix. The short form of the Pain Medication Attitudes Questionnaire (PMAQ-14)

These statements refer to how you feel about pain medication/painkillers. Please circle the number corresponding to how much you agree with each statement.

	Never true	**Almost never true**	**Seldom true**	**Often true**	**Almost always true**	**Always true**
1. I am concerned that taking medication for a long time will lead to addiction	0	1	2	3	4	5
2. I worry that my pain medication/s will stop working	0	1	2	3	4	5
3. I am afraid that stopping my pain medication/s will cause me to feel ill	0	1	2	3	4	5
4. I fear that I am becoming an addict	0	1	2	3	4	5
5. I would be unwilling to reduce my pain medication/s	0	1	2	3	4	5
6. I fear that I will eventually run out of pain medication/s that will help with the pain	0	1	2	3	4	5
7. I worry that withdrawal from my pain medication/s will cause me some harm	0	1	2	3	4	5
8. I find it hard to put up with the side effects from my pain medication/s	0	1	2	3	4	5
9. Needing to take medication for my pain embarrasses me	0	1	2	3	4	5
10. I worry what others think about my use of pain medication/s	0	1	2	3	4	5
11. I worry about damage to my internal organs from my pain medication/s	0	1	2	3	4	5
12. I feel confident about my doctor's management of my pain medication/s	0	1	2	3	4	5
13. I depend on my pain medication/s	0	1	2	3	4	5
14. I feel satisfied with information my doctor gives me about medication/s	0	1	2	3	4	5

Scoring instructions: reverse score items 12 and 14, then compute the mean of the two items for each scale.

Addiction 1 + 4; Need 5 + 13; Scrutiny 9 + 10; Side effects 8 + 11; Tolerance 2 + 6; Mistrust of Doctors 12 + 14; Withdrawal 3 + 7.