

Clinical Pain Research

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Do intensity of pain alone or combined with pain duration best reflect clinical signs in the neck, shoulder and upper limb?

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Abstract

Objectives: It is important to validate self-reported musculoskeletal pain used in epidemiological studies for evaluation of pain outcome measures. The main objective of this paper was to assess the association between self-reported neck/shoulder/upper limb pain and clinical signs of disorders in the region, especially by comparing a measure that only used pain intensity with a measure that combined pain intensity and pain duration.

Methods: Four hundred and twenty technical school students of both genders were included with a median age of 17 years (16–28). The students stated the pain in four intensity grades and the pain duration in four period lengths within the preceding four weeks period. A pain severity index was calculated by multiplying the pain intensity (0–3) and the duration (1–4). A clinical examination was performed within a week after completing the form. The associations were evaluated by agreement, correlation and symmetric strength of association (contingency).

Results: The study found low correlation and low positive agreement for neck/shoulder and upper limb pain related to clinical signs of disorders in the region. However, the relationship showed high negative agreement and high contingency. The negative agreement increased for the neck/shoulder region with higher cut-off points for dichotomization, but not for the upper limb region. The index combining reports of pain intensity with pain duration, do not improve

agreement, correlation or contingency with clinical signs compared to use of pain intensity alone.

Conclusions: This study showed an association between self-reported neck/shoulder/upper limb pain intensity and clinical signs of musculoskeletal disorders of the region. An index combining pain intensity and duration (Pain Severity Index) did not increase this association. From the results we suggest using pain intensity reports alone and if dichotomizing is wanted, choosing a cut-off point at high pain levels, especially for neck and shoulder pain.

Keywords: agreement; clinical signs and disorders; neck and shoulder; pain duration; pain intensity; upper limb.

Introduction

Epidemiological literature commonly describes musculoskeletal pain in terms of presence, intensity, frequency, and duration [1, 2]. The Standardized Nordic Questionnaire (SNQ) [3] is a much used instrument for subjective pain assessment and has shown to have moderate to high reliability and validity [2, 4–7]. However, the SNQ describes only two aspects of pain: the presence of pain (yes or no, the preceding year or the preceding seven days) and its duration during the preceding year [3]. SNQ has no assessment of pain intensity or severity. Several studies have used the information on duration of pain >30 days the preceding year as a measure of “pain severity” [8–12]. Others have supplemented information on pain duration from the SNQ with pain intensity, e.g. by using a Visual Analogue Scale [13, 14]. However, to our knowledge neither of these approaches have been validated.

We have used a verbal rating scale [1, 15, 16] as an instrument for assessment of subjective health complaints which include pain intensity the preceding two or four weeks; no pain (score 0), mild (1), moderate (2) or severe (3) pain. The original studies from our laboratory collected information on the duration for a two weeks period; 1–5 (score 1), 6–10 (2) or

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11–14 (3) days the preceding two weeks [17]. A ‘Pain Severity Index’ (PSI) was constructed by multiplying pain intensity score with the pain duration score. A strong correlation (Spearman’s rho: 0.78) has been found between PSI and clinical (physical) signs in the neck and shoulder region [18]. Corresponding figures for the elbow and forearm region was 0.63 and for the low back 0.59. More recently, we have expanded the period for subjective health complaints to the preceding four weeks and included the period of 15–28 days of duration (score 4) in the index calculation [19, 20]. This instrument has not been validated.

We assume there is a biological plausible relation between pain reports and clinical signs of musculoskeletal disorders in the neck and upper extremity. We also assume that adolescents and young adults is an appropriate study group, since musculoskeletal pain is common in these age groups [21–23].

The main objective of this paper was to assess the association between self-reported neck/shoulder/upper limb pain and clinical signs of disorders in the same regions, with emphasis on comparing a measure only using pain intensity with a measure that combines pain intensity and pain duration. As a secondary objective, we wanted to elucidate how different pain cut-offs affected the association between reported pain and clinical signs.

Methods

Subjects

Four hundred and ninety-four technical school students from 12 schools in the greater Oslo region were contacted and 420 (response rate 85%) were recruited in 2002 to a longitudinal study on risk factors for work-related musculoskeletal pain [19, 20]. Baseline data from that study is used in the present analysis. The major reasons for not participating were lack of motivation or practical reasons, e.g. that

accepted from parents (for those below age 18) was not signed and returned. During ordinary school hours at baseline, the subjects filled in a questionnaire and a clinical examination was carried out by a physiotherapist within a week. Table 1 shows subject characteristics. The student hairdressers were mainly women (98%), while the student electricians were mainly men (96%).

All participants signed an informed written consent form, and the study was approved by the Region South Committee for Medical Research Ethics in Norway (Nr. S-02159, dated 31.08.2002).

Questionnaire

The questionnaire covered a broad spectrum of factors relevant for school and health, including physical and psychosocial exposures at school, educational line, smoking or snuffing habits (Tobacco daily, yes or no), leisure time activities and several health aspects [19]. Students were asked if they have had “Symptoms or pain during the previous four weeks in the neck/shoulders/upper back” (here: neck/shoulder region) and in the “elbows/forearms/hands” (here: upper limb region) [19]. The two regions were showed on a manikin drawing [3], and the students assessed the pain within the regions both for the intensity; no (score 0), mild(1), moderate (2) or severe (3) and if pain also the duration; 1–5 days (1), 6–10 days (2), 11–14 days (3), 15–28 days (4). A Pain Severity Index (PSI, with score from 0 to 12) was calculated by multiplying the pain intensity (0–3) and the duration (1–4). The reliability of this index variable has previously been found acceptable for a two weeks recall period [17], and is not investigated in this paper.

Clinical examination

The clinical examination included measurement of height and weight and the establishment of clinical signs and diagnoses based on procedures and definitions outlined previously [24]. In the present study all students were tested bilaterally for the following diagnoses (pain provoking tests for clinical signs in parenthesis):

- Radiating neck complaints (pain at active or passive head movements against resistance),
- Rotator cuff syndrome (painful arc test or shoulder pain against resistance in shoulder abduction, internal- or external rotation or elbow flexion),

Table 1: Subject characteristics.

	Total n=420 Median (range)	No pain/no clinical signs n=91 Median (range)	Pain/no clinical signs n=221 Median (range)	Clinical signs n=108 Median (range)
Age, years	17 (16–28)	17 (17–26)	17 (16–21)	17 (17–28)
Height, cm	169 (148–194)	173 (157–191)	169 (148–194)	168 (151–192)
Weight, kg	63 (42–123)	65 (44–117)	63 (43–123)	61 (42–109)
	n	n	n	n
Gender (female)	267 (64%)	36 (40%)	150 (68%)	81 (75%)
Tobacco (yes, daily)	154 (37%)	32 (35%)	74 (34%)	48 (44%)
Educational line:				
Electrical	118 (28%)	38 (42%)	54 (24%)	26 (24%)
Hairdresser	167 (40%)	23 (25%)	93 (42%)	51 (47%)
Others ^{a)}	135 (32%)	30 (33%)	74 (34%)	31 (29%)

^{a)}Media/Communication/Design.

- c. Medial or lateral epicondylitis (elbow pain in wrist extension or flexion against resistance),
- d. Flexor-extensor peritendinitis or tenosynovitis of the forearm-wrist region; ‘Tendonitis forearm’ (tests as for epicondylitis but pain in forearm with tender/crepitation), and
- e. Carpal tunnel syndrome (Phalen’s test, Tinel’s sign or flexion/compression test).

A case having a diagnosis was defined if at least one positive sign of musculoskeletal disorder was found in the neck/shoulder region (a–b) or upper limb region (c–e) together with pain symptoms in the relevant region at the time of the clinical examination. However, the presence of clinical signs was noted regardless of the presence or not of accompanying symptoms. Two male and one female physiotherapist performed the clinical examination at school during school hours within a week after the questionnaire was answered. The physiotherapists were blinded to the answers in the baseline questionnaire. They had in beforehand a training period together in order to harmonize the clinical examinations. The reliability of the diagnostic testing was assessed twice. The intra-class correlation coefficient (ICC) was 0.67 (CI 0.35–0.89) after some training and 0.78 (CI 0.44–0.95) at the end of the training period [19].

Statistics

The association between self-reported pain and signs of disorders was assessed by agreement, correlation and contingency. Proportions of total and specific agreement were used as proposed by guidelines when focused on assessment of agreement and not reliability of nominal data [25]. The negative agreement estimates the conditional probability that if subjects do not report pain, the examiner will not find a sign. The positive agreement correspondingly estimates the probability that if a subject reports pain, the examiner will also find a sign. Agreement was interpreted as high >85%, moderate 70–85% and low <70% [2]. In addition we analysed correlation by Spearman’s rho for nominal and ordinal data, correlation interpreted as excellent >0.9, very strong 0.71–0.9, strong 0.51–0.7, weak 0.31–0.5, and “none” <0.3 [26]. Symmetric strength of association or contingency was assessed by Yule’s Q, meaning how closely pairs of data points “match”. Yule’s Q is a special case of the Goodman and Kruskal’s gamma when using a 2 × 2 matrix [27]. Yule’s Q=(ad–bc)/(ad+bc), where “a” represents no pain and no sign; “b” no pain and positive sign; “c” pain and no sign; and “d” pain and positive sign. The Yule’s Q was interpreted as strong ≥0.7, as substantial 0.50–0.69, moderate 0.3–0.49, and poor <0.3 [28].

Different cut-off points were chosen for self-reported pain intensity and PSI. Intensity was graded by scores above the different intensity levels (>0, >1, >2, assignment A–C, see Table 4). The cut-off points for PSI were the different index scores (>0, >1, >2, >3, >4, assignment 1–5, see Table 4).

A two-tailed probability of $p < 0.05$ was chosen as the statistical significance level. The statistical analysis was performed in IBM SPSS Statistics 23.

Results

Symptoms, signs and disorders

Full datasets were collected from all 420 students. Eleven students fulfilled the criteria for one of the clinical

diagnoses tested in the clinical examination, and all together 15 diagnoses were concluded (Table 2). However, 97 students were identified with clinical signs in spite of not having symptoms the same day as the clinical examination. Of the 108 students presenting clinical signs, 42 showed signs of one or both diagnoses in the neck/shoulder and 94 students showed signs of one or more diagnoses in the upper limb (Table 2).

Table 3 shows the proportion of students having clinical signs at different levels of pain intensity and PSI reporting. These two pain measures showed a moderate correlation with the presence of clinical signs. This concerns both the neck/shoulder and the upper limb regions, with correlation coefficients in the range of 0.24–0.26 (Table 3).

The correlation between the pain intensity and pain duration variables were very high (Spearman’s rho); 0.88 for the neck/shoulder region and 0.98 for the upper limb region.

Symptom and sign agreement, correlation and contingency

Table 4 shows the proportion of total agreement and specific positive and negative agreement between pain reporting and presence of clinical signs for different pain cut-off points. The total agreement increases considerably for higher cut-off points for the neck/shoulder pain, but

Table 2: Number of diagnoses and clinical signs found in the clinical tests of the neck/shoulder and upper limb (n=420).

	Clinical diagnosis		Clinical signs ^{a)}		Any level of pain previous four weeks	
	n=11	%	n=108	%	n=420	%
Neck/shoulder pain in questionnaire:					297	70.7
Clinical tests of neck/shoulders: ^{b)}						
Radiating neck pain	3	0.7	11	2.6		
Rotator cuff syndrome	2	0.5	38	9.0		
Upper limb pain in questionna					134	31.9
Clinical tests of both upper limbs: ^{c)}						
Medial or lateral epicondylitis	2	0.5	12	2.9		
Tendonitis forearm	6	1.4	56	13.3		
Carpal tunnel syndrome	2	0.5	56	13.3		

^{a)}Clinical signs, i.e. positive result of provocation tests (with or without clinical diagnosis) ^{b)}seven subjects had a diagnosis and/or clinical signs for both diagnoses in neck/shoulder. ^{c)}Twenty three subjects had a diagnosis and/or clinical signs for more than one of the three diagnoses tested, and seven subjects had a diagnosis and/or clinical signs for all three diagnoses in arm/hand.

Table 3: Pain intensity and pain severity index (PSI) correlated to clinical signs in neck/shoulder and upper limb, respectively (n=420).

	Category	Intensity			Pain severity index			
		N _{tot}	N _{sign}	%	Category	N _{tot}	N _{sign}	%
Neck/shoulder pain	No	123	1	0.8	0	123	1	0.8
Spearman's rho	Mild	186	20	11	1	156	16	10
	Moderate	82	9	11	2-3	55	9	16
	Severe	29	12	41	4	86	16	19
	0.250 ^a				0.239 ^a			
Upper limb pain	No	286	44	15	0	286	44	15
Spearman's rho	Mild	102	34	33	1	82	29	35
	Moderate	22	9	41	2-3	25	7	28
	Severe	10	7	70	4-	27	14	52
	0.264 ^a				0.256 ^a			

N_{tot} is total number of answers and N_{sign} is subjects with clinical signs, both within each category. ^ap<0.05.

Table 4: Association measures between pain reporting and clinical signs (n=420).

	Pain-report dimension	Cut-off point assignment	Cut-off point	Clinical sign/diagn.		Tot. agre. %	Pos. agre. %	Neg. agre. %	Spearman's rho	Yule's Q
				No	Yes					
Neck/shoulder	Intensity	A	=0	122	1	39	24	49	0.197 ^c	0.903 ^c
			≥1	256	41	74	27	84	0.178 ^c	0.524 ^b
			≥2	91	20	89	34	94	0.285 ^c	0.789 ^b
	Pain severity index	1	=0	122	1	39	24	49	0.197 ^c	0.903 ^c
			≥1	256	41	68	27	80	0.183 ^c	0.537 ^b
			≥2	116	25	77	30	86	0.210 ^c	0.593 ^b
			≥3	77	21	77	25	87	0.146 ^b	0.461 ^a
			≥4	70	16	82	25	90	0.155 ^b	0.510 ^a
			≥5	48	13	70	44	79	0.245 ^c	0.532 ^c
			≥1	84	50	78	25	87	0.190 ^c	0.598 ^b
Upper limb	Pain severity index	1	=0	242	44	70	44	79	0.245 ^c	0.532 ^c
			≥1	84	50	75	29	85	0.162 ^b	0.465 ^b
			≥2	31	21	77	23	86	0.155 ^b	0.508 ^a
			≥3	19	15	78	23	87	0.185 ^c	0.616 ^b
			≥4	13	14	78	18	88	0.180 ^c	0.689 ^a

^ap<0.05, ^bp<0.01, ^cp<0.001.

this is less evident for the upper limb pain. The specific positive agreement is low for both neck/shoulder and upper limb regions and for both pain intensity and PSI. However, the specific negative agreement is acceptable and increasing with higher cut-off points, especially for the neck/shoulder region. The correlation between pain reporting and presence of clinical signs is low, showing coefficients between 0.15 and 0.29.

The symmetric strength of association between these two measures (contingency) evaluated with Yule's Q is substantial to strong (Table 4), depending on the chosen cut-off point. If clinical signs of neck/shoulder pain would have been found on four subjects instead of one, then the Yule's Q will be 0.64 and not 0.903 (see first line in Table 4, assignment A).

The agreement, correlation and contingency were also checked between pain duration and clinical signs and similar results were found as for pain intensity.

Discussion

Low correlation and low positive specific agreement were found for self-reported neck/shoulder and upper limb pain related to clinical signs. Moderate to high total and negative specific agreement were found with an increasing trend for higher cut-off points of dichotomization. The symmetric strength of the associations (Yules Q) was high. An index multiplying pain intensity and duration scores (Pain Severity Index, PSI) did not improve the association with clinical signs.

Wang and co-workers examined the relationship between subjective pain reporting and clinical signs in the upper body region among 520 garment workers (mean age 38 years) [29]. The researchers compared answers on intensity and frequency of pain in the neck/shoulder, arm/forearm and hand/wrist regions during the preceding four weeks with at least one clinical sign found in the specific region by a clinical examination. They found that pain reporting was far more common than presence of signs (especially for the neck/shoulder region compared to the elbow/forehand and hand/wrist), and that pain reporting and signs showed low correlation. The correlation increased when the pain group was limited to only those reporting daily pain but was still considered as low. The authors concluded that using either self-reported pain or signs from a clinical examination as an outcome measure in studies on work-related complaints may yield very different results. In the present study we have similar findings while using the same recall time and similar definitions of clinical cases. These findings question our

assumption of a close association between pain reports and clinical signs of musculoskeletal disorders.

On the other hand, among 187 clerical computer workers (mean age 44 years) Perreault and co-workers found that the agreement was fair to good between self-reported neck/shoulder pain symptoms and a standardized clinical examination by an occupational therapist [30]. The definition of symptom cases was pain intensity with a score higher than 50 mm on a 100 mm visual analogue scale (VAS) and with a frequency of three out of the preceding seven days. The demands of high score on VAS for the case definition may explain the fair to good agreement, as also seen in the present study when using a higher cut-off point level for pain.

Contrary to the present study, Steingrimsdottir et al. in 2004 among 60 postal workers (mean age 35 years) found a high correlation between self-reported pain assessed by PSI and a clinical examination. They used the same pain intensity scale, but only a two weeks recall period of pain experience, resulting in a different definition of the PSI variable compared to the present study. In addition their clinical examination was more comprehensive, not only focused on signs of specific diagnoses, and pain intensity was marked in a body-map by a VAS-scale [17]. The shorter recall time for pain and the characteristics of the clinical examination may explain the higher correlations in that study.

The total proportion and the specific negative proportion of agreement were acceptable for most measures in the present study, especially for cut-off point levels focused on severe pain. The positive agreement is rather low in our material, probably explained by a high occurrence of self-reported pain without clinical signs in especially in the neck/shoulder region, to a lesser extent in the upper limb. The decrease of positive agreement proportions related to increasing pain cut-off levels in the upper limb and signs (Table 4.), is due to the finding of many "latent" clinical signs in subjects with no pain.

Dichotomization of skewed data may be beneficial in certain situations, e.g. if contrast is wanted when performing logistic regression. Present data support that a cut-off point of dichotomization for neck/shoulder pain on the highest intensity level gives the best agreement with clinical signs. This was not found for upper limb pain. Fejer et al. categorized the severity of neck "characteristic" pain by comparing a "VAS-like" scale from 0 to 10 with different disability scales [31]. "Characteristic" pain was in that study calculated by the mean score of the average and worst pain reports during the preceding two weeks. They found a single cut-off point around 4–5 dependent on pain characteristics over which pain score had the best

predictive value. The cut-off points were independent of gender, age and duration of pain [31]. Our data do not present optimal cut-off point for neck/shoulder pain since agreement increased up to the highest cut-off point. This is understandable since the reported pain was compared to clinical signs.

The combination of the pain intensity and duration dimensions in the Pain Severity Index (PSI) has previously been introduced for the purpose of getting a better overall subjective pain measure [17]. However, combining these different dimensions (that correlate highly) may have methodological weaknesses (Jensen 2003). Jensen et al. studied cancer related pain and referred to studies that found different associations to clinical states when using pain intensity or duration dimensions. The division of pain duration into four intervals, may also be understood as a measure of how consistent the pain experience was, however it was originally designed to get information on the time dimension. Both interpretations potentially describes a higher pain burden, e.g. if high intensity score is combined with long duration.

The pain intensity alone and the PSI showed similar agreement, correlation and contingency levels, hence, the combination of data on pain intensity and duration in PSI did not improve associations between self-reported pain and clinical signs of musculoskeletal pain. This result may largely be explained by the high correlation between pain intensity and duration reports. We found no other studies on this particular topic. The symmetric strength of the associations (Yule's Q) between pain reports and signs were substantial to strong, indicating acceptable "match" between these measures [28].

Methodological considerations

We followed the Guidelines for Reporting Reliability and Agreement Studies (GRRAS) [25]. These guidelines describe different approaches depending if the focus is on association or reliability. Since we did not focus on reliability of the used methods we did not include kappa, ICC, sensitivity or specificity as measures of reliability.

The clinical signs are not used as "golden standard" but as a reference method, therefore we do not focus on the criterion validity of self-reports. Spearman's rho and Yule's Q are non-parametric measures, where Spearman's rho is a robust method to evaluate correlation. The Yule's Q is a transformation of the odds ratio and gives a coefficient of the symmetric strength of the association (contingency) [27, 32]. It gives an impression of how paired variables are "matching". Yule's Q is not dependent on sample size [33],

but with very small cells the measure becomes sensitive, as demonstrated under results in the present study.

We did not present associations for pain duration alone, because the results were very similar as for pain intensity alone. Since pain duration is less used by researchers, and to a lesser degree describe pain characteristics, we choose to omit that parameter in the presentation.

The low correlation between self-reported pain and signs may partly be of methodological origin. Self-reported pain covered the preceding four weeks and the clinical examination could be up to one week after the questionnaire. Pain states may have fluctuated within this five week time window, as found by many researchers [17, 20, 34]. This means that the subjective report and the examination result would not fit.

Clinical examination of a subset of the most common diagnoses of the neck and upper extremity was performed according to validated guidelines [24]. A weakness is that not all presented tests in the guideline were included in the present study and in addition it exists other clinical pain states [35], including the tension neck syndrome. The latter may defined as neck pain, sense of fatigue or stiffness in the neck, pain radiating from the neck to the back of the head and tender spots in the muscles [36]. The high prevalence of neck/shoulder pain in our young sample, indicates that this syndrome may be present. The overlap between self-reported pain and signs may have been improved if taken into account most possible clinical states in the neck/shoulder and upper limb. Another weakness may be that the participants all were young, with fewer symptoms and signs compared to older subjects and perhaps also with other pain perception characteristics [37]. The dataset is rather old, but we can't see that it has any influence on the design, analyses or results of the study.

The statistical strength is increased by use of clinical signs instead of diagnoses. This could on one hand, be viewed upon as a weakness of our study, since also latent muscle pain will be included that do not necessarily have a clinical picture of musculoskeletal pain. On the other hand, the clinical examination exhibits an external evaluation of tissue affection less dependent of the subjects own experienced pain and on the fluctuation of experienced pain.

Conclusions

Self-reports of pain will mostly exaggerate the occurrence of clinical relevant musculoskeletal pain, but self-reports are necessary to use since clinical examinations of many

subjects often is difficult to achieve. The present study found low correlation but substantial or strong “match” between pain-reports and clinical signs. In dichotomizing the pain reports, increased level of the cut-off point also increased the association for the neck/shoulder pain, but not for the upper limb pain. Combining reports of pain intensity with pain duration (Pain Severity Index), do not improve the association with clinical signs compared to the use of pain intensity alone.

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Author contributions: SK developed the original questionnaire, KBV, TNH and MW performed data collection, KBV made the calculations and wrote the first version of the manuscript, SK, LKL, MK, KBV, TNH and MW discussed results, interpretation, conclusions and provided comments on the final shape of the manuscript.

Competing interests: The authors state no conflict of interest.

Informed consent: Informed consent has been obtained from all individuals included in this study.

Ethical approval: The study was performed in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 1983, and the study was approved by the Region South Committee for Medical Research Ethics in Norway (Nr. S-02159, dated 31.08.2002).

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