Painful Discrimination in the Emergency Department: Risk Factors for Underassessment of Patients' Pain by Nurses

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Introduction: Unrelieved acute musculoskeletal pain continues to be a reality of major clinical importance, despite advancements in pain management. Accurate pain assessment by nurses is crucial for effective pain management. Yet inaccurate pain assessment is a consistent finding worldwide in various clinical settings, including the emergency department. In this study, pain assessments between nurses and patients with acute musculoskeletal pain after extremity injury will be compared to assess discrepancies. A second aim is to identify patients at high risk for underassessment by emergency nurses.

Methods: The prospective PROTACT study included 539 adult patients who were admitted to the emergency department with musculoskeletal pain. Data on pain assessment and characteristics of patients including demographics, pain, and injury, psychosocial, and clinical factors were collected using questionnaires and hospital registry.

Results: Nurses significantly underestimated patients' pain with a mean difference of 2.4 and a 95% confidence interval of 2.2-2.6 on an 11-points numerical rating scale. Agreement between nurses' documented and patients' self-reported pain was only 27%, and 63% of the pain was underassessed. Pain was particularly underassessed in women, in persons with a lower educational level, in patients who used prehospital analgesics, in smokers, in patients with injury to the lower extremities, in anxious patients, and in patients with a lower urgency level.

Discussion: Underassessment of pain by emergency nurses is still a major problem and might result in undertreatment of pain if the emergency nurses rely on their assessment to provide further pain treatment. Strategies that focus on awareness among nurses of which patients are at high risk of underassessment of pain are needed.

Key words: Emergency department; Acute pain assessment; Discrepancies, underassessment; Risk factors

Pain is a multidimensional phenomenon in which pain experience of patients is determined by the interactions of physical, psychological, cultural, and sociodemographic factors.[1] Patients vary markedly in the intensity of their pain in response to an identical procedure, injury, or noxious condition. Because of the subjective nature of pain, it can be very difficult to quantify patients' pain. A clinically objective measurement for the experience of pain is not available. Therefore, the assessment of this inherently subjective symptom relies on patients' self-report. Underassessment of pain may occur when clinicians, such as emergency nurses, attempt to calculate the severity of patients' pain experiences, thereby placing patients at risk of inadequate pain relief.[2,3]

Although pain is the most prevalent chief complaint for patients visiting the emergency department,[4–6] undertreatment of acute pain appears worldwide, which is reflected by the high prevalence of moderate to severe

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pain at discharge and the low percentage of patients receiving analgesics. The proportion of adults receiving analgesics varies between 19% and 64%.[4,7–11] Moreover, the percentage of patients discharged with moderate to severe pain ranges from 52% to 74%.[4,6,8,11]

Accurate assessment of pain is a crucial step in providing effective pain management. Discrepancies between patients' and clinicians' assessment are identified as the most powerful predictor of poor pain management.[12,13] The consequences of inaccurate assessment are substantial. Underassessment of pain can lead to inadequate pain management, unnecessary suffering, and delay in recovery, while overassessment of pain can lead to overtreatment and potentially to iatrogenic disease.[14] Major underestimations in pain assessment are noted in patients with musculoskeletal pain, where the discrepancy in assessment of pain between patients and clinicians is considerable.[2,3,15] As a result, insufficient pain relief occurs frequently in these patients.[4,16–18]

Given the multidimensional nature of pain and the complexity of pain assessment, it is likely that different clinician, patient, and environmental characteristics are involved in accurate pain assessment.[14] In several studies it was found that experienced clinicians have a tendency to underestimate patients' pain. However, a study that investigated the agreement of pain assessment between patients and emergency nurses revealed that characteristics such as the nurse's sex, age, ED experience, nursing grade, and previous attendance to pain management courses were not associated with inaccurate pain assessment.[2]

Patients' behavior and characteristics may have an influence on the assessment. However, except for some demographic characteristics such as age and sex, not much is known about which individual injury factors play a role. Therefore, our goal is to identify patients for whom pain is likely to be underassessed by emergency nurses. Identifying risk factors for underassessment of pain might reduce pain rating discrepancies, optimize pain management, and as a result reduce unnecessary suffering and improve recovery and patient outcome.

Methods

STUDY DESIGN AND SETTING

This study is part of a prospective follow-up study; the "PROgnostic factors for the Transition from Acute to Chronic pain in Trauma patients" (PROTACT). The PROTACT study includes adult patients with isolated musculoskeletal extremity injury who attended the emergency department of Medisch Spectrum Twente in Enschede, The Netherlands. This 24/7 emergency service is accessible for 264,000 persons in the Twente region and treats approximately 27,000 patients annually. This study was approved by the regional Medical Research Ethics Committee on Research Involving Human Subjects (CCMO No. NL368.38044.11). Written informed consent was obtained from each participant.

STUDY POPULATION

Eligible patients aged 18 to 69 years were consecutively recruited in the study when admitted to the emergency department during a 22-month period from September 2011 until July 2013. Inclusion criteria for participation were: (1) musculoskeletal isolated extremity injury caused by blunt trauma and (2) sufficient communication skills and a basic knowledge of the Dutch language. Exclusion criteria were: (1) life- or limb-threatening conditions; (2) documented cognitive disability; (3) suffering from hallucinations, delusions, or suicidal ideation; and (4) alcohol or drug intoxication. For the purpose of this study, patients who did not fill in the questionnaires at ED admission and 6 weeks follow-up were excluded.

PROCEDURES AND DATA MANAGEMENT

Patients admitted to the emergency department who met the study criteria were informed by a (triage) nurse about the purpose of the study. Participants were asked to provide informed consent and to complete a questionnaire. Six weeks after the initial ED visit, patients received a follow-up questionnaire by (E)mail, according to their stated preference. The questionnaires consisted of validated questionnaires that are frequently used in pain research (described later). Furthermore, questions about sociodemography, lifestyle, injury, and treatment were included. Additional data from the ED electronic patient registration system were used. The registry is a fully electronic emergency medical record registry in which each entry, order, or activity is automatically time stamped for prespecified ED events. The registry includes patient demographics (date of birth, sex), triage urgency level, nurses pain score, and medical diagnoses—for example, injury type and location. If patients arrived by ambulance, additional data regarding the use and type of analgesic pain management were retrieved from the registry of the regional ambulance services.

The following validated questionnaires were used.

Pain Intensity

Pain intensity at ED admission was measured using a Numerical Rating Scale (NRS). Patients were asked to fill in a number from 0 to 10 to represent their pain intensity, where 0 is "no pain" and 10 "the worst pain imaginable." The NRS was validated for use in the emergency

department.[19] During triage, the nurse also registered a pain score in the patient's medical record.

Pre-injury Physical and Mental Health Status

Physical and mental health was measured using the validated Dutch-language version of the 36-Item Short-Form Health Survey (SF-36).[20] The SF-36 is a general quality of life questionnaire with a 4-week recall period and assesses 8 domains, for example, physical functioning, pain, mental health, vitality, and general health perception.[21] Algorithms were used to produce the Physical Component Summary (SF-36 PCS) scores for physical health status and Mental Component Summary (SF-36 MCS) scores for mental health status.[22] In the present study, the first quartiles of the obtained SF-36 PCS (<51.7) and SF-36 MCS (<49.7) scores were defined as the cutoff points for poor physical or mental health.[23]

Pre-injury Anxiety and Depression

Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS). The Dutch version of the HADS was validated and was found to have good psychometric properties.[24] The HADS is a screening tool for assessment in a wide variety of clinical groups, such as emergency care patients.[25] Patients were asked to recall a 7-day period about 14 items on a 4-point Likert scale—7 items for each subscale of anxiety and depression. The anxiety and depression sum scores were calculated (range 0-21), with a high score indicating a high level of anxiety or depression. In the present study, a sum score of >7 was used to indicate the presence of anxiety and depression.[24]

Pain Catastrophizing

Pain catastrophizing is conceptualized as a negative cognitive–affective response to anticipated or actual pain and was measured by using a Dutch-language version of the Pain Catastrophizing Scale (PCS) consisting of 13 statements of pain experience; for example: "If I am in pain, I am afraid the pain will get worse." Patients were asked to indicate whether they agree with these statements by using a 5-point Likert scale. A PCS sum score was calculated from all items (range 0-52), with a high score indicating a high level of pain catastrophizing. In the current study, a score of 24 of higher was used to indicate the presence of pain catastrophizing. This cutoff point was found to be highly associated with high follow-up pain ratings.[26] Several studies have supported the validity and reliability of PCS.[27] The PCS was measured at 6 weeks.

Kinesiophobia

Kinesiophobia, or fear of movement, refers to the anxiety that many individuals in pain have regarding engaging in activities or physical movements and was measured by the Tampa Scale of Kinesiophobia (TSK). The TSK consists of 17 statements that reflect the notion that pain is a precursor for (re)injury because of physical activity or certain movements.[28] Patients were asked whether they agree with these statements by using a 4-point Likert scale. A TSK sum score was calculated by using all items (range 17-68); a high score indicates a high level of kinesiophobia. A score of 37 or higher was used to indicate the presence of kinesiophobia.[29] The Dutch-language version TSK has been shown to be internally reliable and correlates with measures of other disability.[29] The TSK was measured at 6 weeks follow-up.

PRIMARY OUTCOME MEASURE

The primary outcome was disagreement in pain severity rating between self-reported pain intensity by the patient and documented pain intensity by the nurse. Pain disagreement was present if the ratings differed by ≥33%. A difference of 33% represents clinical significance.[30] The difference in pain ratings was calculated by subtracting the nurse's rating from the patient's rating, divided by the patient self-reported pain rating * 100%. The focus of this study was on the underassessment of patients' pain.

POTENTIAL RISK FACTORS FOR UNDERASSESSMENT OF PATIENTS' PAIN

The following variables were analyzed for their prognostic value, because these may play a role in pain signaling, transition, perception, or modulation.

- Demographics: Age, sex, and educational and lifestyle factors (alcohol consumption and smoking)
- Pain factors: Pre-existing chronic pain (pain longer than 3 months before injury) and the use of analgesics in the prehospital phase
- Psychosocial factors: pre-injury anxiety and depression measured with HADS, catastrophizing measured with PCS, kinesiophobia measured with TSK, and mental health status measured with SF36.
- Injury factors: Type of injury, site of injury, time between injury and ED admission, and urgency level
- Clinical factors: Physical health status measured with SF36, self-reported comorbidities, and body mass index (BMI)

DATA ANALYSES

For descriptive purposes, categorical data were characterized in terms of frequency (%), whereas continuous data were characterized as median with interquartile ranges (IQR, 25th-75th percentile) or as mean ± standard deviation (SD). Spearman correlation coefficients and Bland-Altman plots were used to give a graphical demonstration of the relationship between a nurse's pain score and a patient's self-reported pain scores. For the purpose of this study, the primary outcome disagreement was dichotomized into no underassessment $<33\%$ and underassessment $\geq 33\%$. The potential association between categorical variables and underassessment were investigated using χ^2 tests. Odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated.

Because preselection of risk factors based on *P* values estimated from univariate analyses may result in unstable prediction models,[31] all potential risk factors were considered in the multivariate analysis. Backward stepwise selection of all potential risk factors was applied using the likelihood ratio test with a *P* value of .157 according to Akaike's Information Criterion. If multicollinearity between 2 variables was suspected, change of estimates, confidence intervals, and *P* values were evaluated when both variables were included in the model compared with the inclusion of one variable.The model's ability to discriminate accurately assessed patients from the underassessed patients was ascertained by concordance (c)-statistic, which can range from 0.5 (no discrimination) to 1.0 (perfect) discrimination. A bootstrapping procedure (250 samples) was used to assess the internal validity of the multivariate model. This procedure produced a corrected model's c-statistic and a shrinkage factor. The regression coefficients (β) of the risk factors were then multiplied by this shrinkage factor to prevent overfitting and optimism of the model when applied to new patients. The adjusted odds ratios (ORadj) and corresponding 95% CIs were calculated. In the final model, the R^2 Nagelkerke was used as a measure of the power of combined variables in predicting underassessment. All data analyses were performed with SPSS version 21.0 (IBM Corp, Armonk, NY) and R software version 3.0.3 (R Foundation, Vienna, Austria).

Results

PATIENTS' CHARACTERISTICS

Between September 2011 and July 2013, a total of 803 adult patients with isolated musculoskeletal extremity injury provided written informed consent. Data for 541 patients who filled in both the ED and follow-up questionnaire were used for analyses. For 2 patients, the nurse's pain score was not registered and therefore those patients were excluded from analyses. The median age of the 539 patients was 45.9 years (interquartile range 33.9-59.2), and 57.9% were women (Table 1). Pain prevalence at admission was high; 533 of 539 patients (98.9%) reported pain. Most patients (73.1%) had a fracture; common injury sites were the wrist (16.8%) and ankle (21.6%). Before injury, 5.2% of the patients had symptoms of depression, 9.6% had symptoms of anxiety, 3.9% had symptoms of pain catastrophizing, and symptoms of kinesiophobia were present in 40.4% of patients.

DISAGREEMENT IN PAIN ASSESSMENT

The average patients' self-reported pain score was NRS 6.5 (95% CI 6.3-6.7), and the nurses' pain score was NRS 4.0 (95% CI 3.9-4.1), a difference of 2.4 (95% CI 2.2-2.6) ($P < .01$). A comparison of nurses' and patients' self-reported pain scores gives a Spearman correlation coefficient between the 2 measures of 0.36.

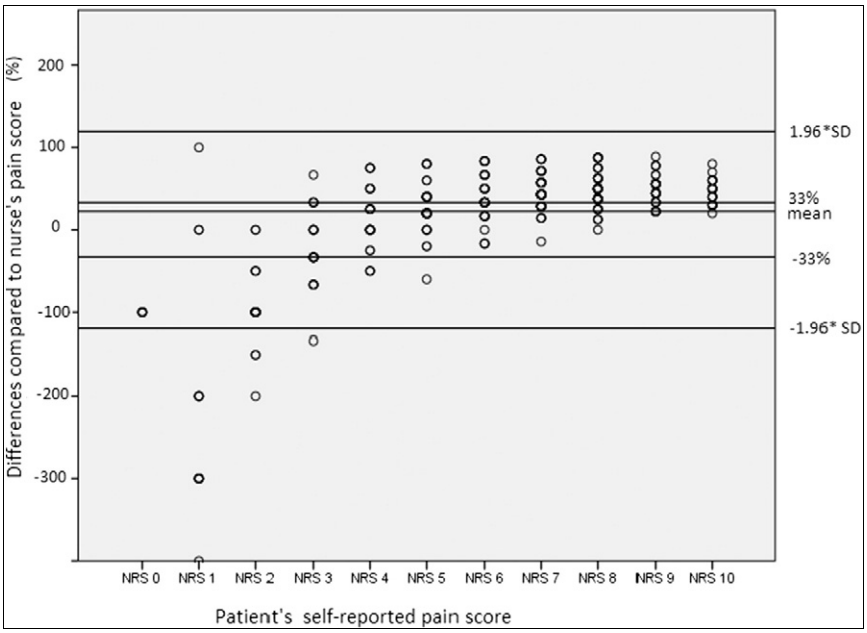
A Bland-Altman plot of the differences in pain measures is shown in the Figure. The plot includes the mean and 1.96 SD lines, as well as reference lines depicting 33% and –33%. Pain score discrepancies between –33% and 33% represent a difference that is not clinically relevant. Many data points are outside this range. The agreement between nurse's and patient's self-reported pain score was only 27%. Sixty-three percent of nurses rated the patient's pain level as less intense than patients' self-reported level, and almost 10% of nurses overassessed patients' pain. The Figure shows that the more severe the patient's pain is, the more often pain is underassessed by the nurse. However, the margin of error in pain assessment is higher when patients reported mild pain.

RISK FACTORS FOR UNDERASSESSMENT OF PAIN

Most potential risk factors were in univariate models to some extent associated with underassessment by nurse except for age, BMI, kinesiophobia, and physical health (Table 2). However, only 7 risk factors including sex, educational level, prehospital analgesic use, site of injury, smoking, anxiety and urgency level independently contributed to the prediction of underassessment (Table 3). Other risk factors, which seemed relevant in univariate models such as type of injury and time between injury and ED visit, were not independent risk factors. Apparently, their predictive information was already covered by the remaining prognostic factors. The reduced model including the seven predictors showed good calibration (nonsignificant Hosmer-Lemeshow test $P = .99$) and discriminative ability (c-statistic 0.72; 95% CI 0.66-0.76). Internal

TABLE 1
Characteristics of 539 patients with acute musculoskeletal trauma

Variable	N (%)
Sociodemographics	
Age (in years), median (IQR)	45.9 (33.9-59.2)
Sex *Women*	313 (57.9%)
Educational level	
Low	78 (14.5)
Medium	286 (53.1)
High	172 (31.9)
Pain factors	
Prehospital analgesic use	200 (37.1)
Pain at admission	533 (98.9)
Injury factors	
Injury type	
Fracture	394 (73.1)
Luxation	26 (4.8)
Distortion	66 (12.2)
Contusion	42 (7.8)
Muscle rupture	11 (2.0)
Site of injury: lower extremities	278 (51.6)
Urgency level	
Standard	375 (69.6)
Urgent	143 (26.5)
Very urgent	21 (3.9)
Time between injury and ED admission	
<2 h	255 (47.3)
≥2 and ≤24 h	202 (37.5)
>24 h	82 (15.2)
Clinical factors	
RAND 36, Physical Component Score, median (IQR)	56.4 (51.7-58.7)
Poor physical health (<51.7)	134 (24.9)
Psychosocial factors	
RAND 36, Mental Component Score, median (IQR)	54.5 (49.7-57.3)
Poor mental health (<49.7)	134 (24.9)
HADS score depression, mean (SD)	3.5 (3.1)
Symptoms of depression (>7)	28 (5.2)
HADS score anxiety, mean (SD)	1.9 (2.8)
Symptoms of anxiety (>7)	52 (9.6)
Pain Catastrophizing Scale score, mean (SD)	8.4 (7.3)
Symptoms of pain catastrophizing (≥24)	21 (3.9)
Tampa Scale for Kinesiophobia score, mean (SD)	35.7 (6.4)
Symptoms of kinesiophobia (≥37)	218 (40.4)



FIGURE

Bland-Altman plot of the differences between nurse's and patient's self-reported pain scores. The area whithin the lines of 33% and -33% represents no clinically relevant difference on a NRS for acute pain. It is evident that many data point lie outside this range

validity was good; the bootstrapping procedure yielded an optimism-corrected c-statistic of 0.70 and a shrinkage factor of 0.86. Urgency level (Orad j= 11.51, 95% CI 4.61-63.56) and anxiety (Oradj = 2.22, 95% CI 1.08-5.95)) were strong prognostic factors for underassessment of patients' pain levels. With the risk score presented underneath Table 3, the risk of underassessment can be calculated for each individual patient.

Discussion

Assessment of pain is difficult because pain is a highly subjective and personal experience, which is hardly clinically measurable with objective criteria. In the PROTACT study, nurses significantly underassessed patient's pain with a mean difference of 2.4 on an 11-points NRS. More important than a statistical significant difference between both assessments is the issue of clinical relevant difference. Earlier findings have demonstrated that a difference of 33% in acute pain scores is clinically relevant,[30] so pain assessments between nurses and patients are deemed to be accurate if the differences between the 2 scores are even or less than 33%. In a majority of 63%, patient's pain was underassessed by the emergency nurse, and in almost 10% the nurse overassessed patients' pain intensity. Pain was particularly underassessed in women, in persons with a lower educational level, in patients who used prehospital analgesics, in smokers, in patients with injury to the lower extremities, in anxious patients, and in patients with a lower urgency level.

The literature already suggested that clinicians, including nurses, have a tendency to underassess patient's pain.[14] Discrepancies between patients' self-reported pain intensity and the documented pain intensity by clinicians were described in different clinical settings.[2,3,14,32–34] These discrepancies are remarkably consistent across patient diagnoses and clinical settings.[14] Of concern is the trend to underassess patients' pain, especially in patients who report severe pain.[14] In the present study, the pain of patients with severe pain was more often underassessed, while the pain of patients with mild pain was more often overassessed.

In the emergency department, the percentage of underassessment of pain is high, ranging from 40% to 77%. The highest underassessment of pain levels is noted in patients with musculoskeletal injuries and abdominal pain.[2,3] One study revealed the percentage of underassessment in patients with musculoskeletal injuries, fractures, or dislocations to be even up to 79%.[3] This PROTACT-study found a percentage of 63% underassessment in a musculoskeletal pain population, which included patients with severe injuries like complex fractures, as well as patients with mild injuries such as small contusions. This percentage seems to be reliable, but is

TABLE 2
Potential risk or protective factors predictors of underestimation of patient's pain by the nurse (n = 539)

Variable	Pain intensity at ED admission		
	Underestimation, n (%)	OR (95% CI)	*P* value
Sociodemographics			
Age, y			
18-29 (reference)	72/112 (64.3)	1	.98
30-39	43/66 (65.2)	1.04 (0.55-1.96)	
40-49	64/105 (61.0)	0.87 (0.50-1.50)	
50-59	80/129 (62.0)	0.97 (0.54-1.53)	
60-69	81/127 (63.8)	0.98 (0.58-1.66)	
Sex			
Men (ref.)	129/227 (56.8)	1	
Women	211/312 (67.6)	1.59 (1.11-2.26)	.01
Educational level [1]			
High (reference)	99/172 (57.6)	1	.17
Medium	186/286 (65.0)	1.37 (0.93-2.02)	
Low	53/78 (67.9)	1.56 (0.89-2.75)	
Alcohol consumption			
Weekly or less (reference)	160/246	1	.37
More than once a week	175/286	0.85 (0.60-1.21)	
Smoking			
No (reference)	297/444	1	.07
Yes	64/89	1.62 (0.98-2.67)	
Pain factors			
Pre-existing chronic pain [1]			
No (reference)	261/425 (61.4)	1	.14
Yes	76/110 (69.1)	1.41 (0.90-2.20)	
Prehospital analgesics use			
No (reference)	199/335 (59.4)	1	.02
Yes	139/200 (69.5)	1.56 (1.07-2.26)	
Injury factors			
Type of injury			
Fracture (reference)	242/394 (61.4)	1	.02
Luxation	12/26 (46.2)	0.54 (0.24-1.20)	
Others	86/119 (72.3)	1.64 (1.04-2.57)	
Site of injury			
Upper limb (reference)	150/261 (57.5)	1	.01
Lower limb	190/278 (68.3)	1.60 (1.12-2.27)	
Urgency level			
Standard (reference)	265/375 (70.7)	1	<.01
Urgent	72/143 (50.3)	0.42 (0.28-0.63)	
Very urgent	3/21 (14.3)	0.07 (0.02-0.24)	

continued next page

Table 2
Continued

Variable	Pain intensity at ED admission		
	Underestimation, n (%)	OR (95% CI)	*P* value
Time between injury and ED visit			
>24 hours (reference)	55/82 (67.7)	1	.07
≥2 and ≥24 h	137/202 (67.8)	1.04 (0.60-1.79)	
<2 h	148/255 (58.0)	0.68 (0.40-1.15)	
Clinical factors			
Physical health status			
Good (reference)	250/401 (62.3)	1	.40
Poor	89/134 (66.4)	1.20 (0.79-1.80)	
BMI [2]			
Normal weight (reference)	174/284	1	.84
Underweight	5/8	1.05(0.25-4.50)	
Overweight	117/179	1.19 (0.81-1.76)	
Obesity	/59	1.14 (0.64-2.05)	
Comorbidity			
No (ref.)	234/379	1	.33
Yes	106/160	1.21 (0.83-1.79)	
Psychosocial factors			
Anxiety before injury [2]			
No (reference)	294/482 (61.0)	1	<.01
Yes	43/52 (82.7)	3.44 (1.58-7.47)	
Depression before injury [2]			
No (ref.)	315/505 (62.4)	1	.18
Yes	21/28 (75.0)	1.81 (0.76-4.34)	
Pain catastrophizing [3]			
No (ref.)	307/486 (63.2)	1	.10
Yes	17/21 (81.0)	2.47(0.82-7.48)	
Kinesiophobia [3]			
No (ref.)	177/285 (62.1)	1	.42
Yes	143/218 (65.6)	1.16 (0.81-1.68)	
Mental Health status			
Good (reference)	246/402 (61.2)	1	.07
Poor	93/133 (69.9)	1.47 (0.97-2.25)	

[1] Missing 1 ≤5.
[2] Missing 5 ≤10.
[3] Missing 10 ≤ 40

difficult to compare with other studies because of variation in methodologies (eg, different cutoff points for accurate assessment and discrepancy) and study population. The present study found a moderate correlation assessment of 0.36 between patients' and nurses' assessments. This is in line with earlier correlations ranging between 0.21 and 0.38.[33,35,36]

It seems there is a lack of good pain assessment. Because pain cannot be proved or disproved, a patient's pain intensity self-reports should be accepted as the gold standard and take precedence over a patient's behavior and vital signs. However, earlier findings show that observations of patients' pain behavior is the most potent factor in decision making related to pain.[37] The discrepancies in this study

TABLE 3
Reduced and extended (final) model to predict underestimation of patient's pain by the nurse (n = 486 [#])

Factor	Reduced model		Extended (final) model	
	β	*P*	β [*]	ORadj (95% CI) [*]
Sociodemographic factors				
Sex, women	0.43	.04	0.37	1.45 (1.03-2.33)
Educational level Middle (versus High)	0.20	.37	0.18	1.19 (0.79-1.91)
Educational level Low (versus High)	0.72	.04	0.62	1.85 (1.05-4.00))
Smoking	0.58	.05	0.49	1.64 (0.98-3.21)
Pain-related factors				
Analgesics use before admission	0.38	.08	0.33	1.38 (0.95-2.24)
Biomedical factors				
Site of injury, lower extremity	0.47	.02	0.40	1.50 (1.07-2.39)
Psychosocial factors				
Anxiety	0.93	.03	0.80	2.22 (1.08-5.95)
Others				
Urgency level urgent (vs very urgent)	1.72	.01	1.48	4.38 (1.48-21.03)
Urgency level standard (vs very urgent)	2.84	<.01	2.44	11.51 (4.61-63.56)
Intercept	-2.83		-2.35	
C-statistic	0.72			
Nagelkerke R^2	0.19		0.15	

Probability of underestimation of patients pain level= 1/(1 + exp (- (-2.35 + 0.37 * (sex_women) + (0.18 (educational level_medium) or 0.62 (education level_low)) + 0.33 * (analgesic use before admission) + 0.40 * (site of injury_lower extremity) + 0.80 * (anxiety) + 0.49* (smoking) + ((1.48 * urgency level_urgent) or (2.44*urgency level_standard))).

[*] Regression coefficient and corresponding odds ratio after bootstrapping (i.e. adjusted for overfitting). The shrinkage factor was 0.86.

[#] 53 missing values in multivariate analysis

also show that nurses do not rely on patients' self-reported pain and documented a pain score that is in most cases (63%) less intense. One reason might be that nurses often believe that patients exaggerate reports of pain.[36]

The PROTACT study revealed an association for several sociodemographic factors with underassessment of pain. Women are at higher risk for underassessment of their pain levels than are men. Differences in pain perception between men and women have been reported before in emergency departments.[38–41] Women experience more intense pain and are more sensitive to pain, both in clinical and experimental settings.[42] Moreover, a prospective study found that women were 13% to 25% less likely than men to receive analgesics.[43] Difference in educational level is a commonly used marker for social inequality. In current study, patients with a lower educational level are at high risk for underassessment, in contrast with a study in surgery patients with abdominal pain, in which educational level was unrelated to a difference between nurses' assessment and patients' assessment.[33]

In the PROTACT study, one third of the patients had already used analgesics before attending the emergency department—somewhat less than the 44% found in previous studies.[5] Patients who already used analgesics in the prehospital phase had a higher risk to be rated as having less severe pain by the nurse. The analgesics may not yet fully work between the time of injury onset and ED admission, but nurses might take the analgesic use, the lagging possible pain relief, into account during their assessment of pain. Furthermore, the ability to assess patients' severity of injury was in this study limited to ED-assigned triage urgency categories. A low urgency level seems to be a really strong predictor for underestimation of patient's pain, suggesting the pain of patients with minor injuries will be more underassessed.

Many psychological factors have been indicated as potential prognostic factors for individual pain experiences, such as kinesiophobia, anxiety,[44,45] and catastrophizing.[46] Of all psychological measures, anxiety is the only independent risk factor for underassessment of pain. The positive relationship between anxiety and pain is a common experience in clinical settings. Anxiety levels have been shown to predict pain severity and pain behavior in acute pain patients.[47] Anxiety can also

exacerbate the pain sensation.[48] Studies have confirmed the enhancing effect of anxiety on pain for different components and measures of pain, for example, ratings of pain intensity and pain discrimination.[44,45]

The implications of cigarette smoking to the practice of pain medicine are complex and not well understood. Smoking a nicotine-containing cigarette nearly doubled the pain awareness thresholds in an experimental setting, and pain tolerance thresholds were also elevated. On the other hand, nicotine has been shown to have analgesic properties. The complex relationship between the multiple factors for example psychosocial factors associated with smoking needs to be explored to elucidate the mechanisms responsible for the interaction.[49]

The low value of explained variance in the prediction model means that the independent risk factors can only explain a small fraction of variance between the individual patients. Variables might have been missed that play a role in the complexity of pain and influence discrepancies in pain assessment between patients and nurses, such as patient-nurse interaction and nurse and environmental characteristics. Studies are needed that include all these possible factors.

Implications for Emergency Nurses

Knowing which factors can increase risk for discrepancies in pain assessment is a necessary first step toward optimizing pain management and pain relief. Nurses should be aware in which patients they usually underassess the pain. Underestimation of patients' pain can have negative effects if appropriate treatment is withheld, not only in terms of patient suffering, but unrelieved pain may also lead to adverse physiological effects such as cardiovascular side effects and negative effects on respiratory function, coagulation, and immune function.[50,51] Pain assessment is the keystone of adequate pain management. Unfortunately, the PROTACT study shows that inaccurate assessments are more the rule than the exception. This may highlight a need for better education for nurses about pain and pain assessment. An unwritten assumption that is evident within the literature is that pain management would improve if pain assessment tools were used routinely in clinical practice. By drawing attention to patients' self-reported pain and minimizing assumptions, and with the routine use of pain assessment tools, pain management in the ED might improve.

In summary, several issues can be learned and built upon from this study. Inaccurate assessment of pain is still a problem, which results in undertreatment of clinically unacceptable pain if nurses rely only on their own assessment of pain to provide pain treatment. This might lead to unnecessary suffering and delay the patient's recovery. Strategies focusing on awareness among nurses of which patients are at high risk for underassessment of pain are needed. From a clinical point of view, further studies are needed to examine whether more accurate pain assessment improves pain management and other patient outcomes.

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