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Persistent postsurgical pain in a general population: Prevalence and predictors in the Tromsø study

Aslak Johansen [a,*], Luis Romundstad [b], Christopher S. Nielsen [c], Henrik Schirmer [d], Audun Stubhaug [e]

[a] Division of Surgical Medicine and Intensive Care, University Hospital of North Norway, Tromsø, Norway
[b] Division of Emergencies and Critical Care, Oslo University Hospital, Rikshospitalet, Oslo, Norway
[c] Department of Mental Health, Norwegian Institute of Public Health, Oslo, Norway
[d] Department of Clinical Medicine, University of Tromsø, Tromsø, Norway
[e] Department of Pain Management and Research, Oslo University Hospital and Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, Norway

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ABSTRACT

Population-based data on the prevalence of persistent postsurgical pain are scarce. This study aimed to assess the prevalence of persistent postsurgical pain in a general population and to describe associated physical, social, and psychological factors, including symptoms of nerve injury and sensitization. A cross-sectional survey was performed in northern Norway with questionnaire items covering surgery, pain, and sensory abnormalities in the area of surgery. Of the 12,982 participants, 24.0% (3111) had undergone one or more surgical procedures during the 3 years preceding the survey. Of these, 2043 had the surgery performed more than 3 months before the investigation. Persistent pain in the area of surgery was reported by 40.4% of the patients (826 of 2043), moderate or severe pain by 18.3% (373 of 2043). Hypoesthesia, hyperesthesia, or both was reported by 24.5% (501 of 2043). There were strong associations between sensory abnormalities and persistent pain, increasingly with higher pain intensities; odds ratios were 2.68 for hypoesthesia and 6.27 for hyperesthesia. Of the 826 individuals reporting persistent pain in the anatomical area of surgery, 51.0% reported chronic pain when questioned without specific reference to the surgery. The present study supports evidence from clinical studies of persistent postsurgical pain, indicating a high prevalence, but reveals large discrepancies in report of pain, depending on the questions asked and the context in which the questions are presented. Strong associations between sensory abnormalities and pain indicate neuropathic mechanisms in a major proportion of cases.

1. Introduction

During the last 2 decades, numerous studies have indicated a high prevalence of persistent pain after common surgical procedures. In 1998, Crombie et al. reported that surgery contributed to chronic pain in 22.5% of patients referred to pain clinics in northern Britain [6]. Other studies have found that half of the patients experience persistent pain after breast cancer surgery [7,26,34]. Persistent pain and sensory abnormalities are also common after breast augmentation surgery in otherwise healthy women: Romundstad et al. found that 13% to 20% of surgery patients reported pain 1 year after surgery, whereas von Sperling et al. identified 9.5% with moderate to severe pain after a mean follow-up time of 31 months [30,37]. Thoracotomies are reported to be followed by persistent pain in 25% to 60% [26,38], sternotomies in 17% to 27% [12,18,23], herniotomies in 5% to 12% [1,15,26], hysterectomies in 5% to 32% [3,4], and amputations in 50% to 80% of cases [25,26]. These studies were all follow-up studies of selected surgical patient groups, and less is known about the prevalence of persistent postsurgical pain (PPSP) in the general population. We have only been able to identify 1 study addressing this issue: Breivik et al. [5] conducted an international survey of chronic pain in 15 European countries and Israel, where 3% of the individuals who reported chronic pain indicated surgery as the cause. However, PPSP was not the focus for this telephone-based survey, and surgery was only one of several options that the respondents could choose as the assumed reason for their chronic pain.

Persistent pain after surgery is not only an important topic of research in its own right, but also a model for exploring the mechanisms underlying the change from acute to chronic pain.

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* Corresponding author. Address: Division of Surgical Medicine and Intensive Care, University Hospital of North Norway, Sykehusveien 38, 9007 Tromsø, Norway. Tel.: +47 77 66 91 56/97 59 93 47; fax: +47 77 62 61 92.
E-mail address: aslak.johansen@unn.no (A. Johansen).

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Preoperative pain, concomitant pain conditions, and general physical functioning before surgery have all been shown to be associated with persistent postsurgical pain [25,28]. Evidence indicates that psychological factors, including state anxiety and depression [35], fear of surgery [27,28], psychic vulnerability [10], and catastrophizing [17], are associated with increased risk for chronic pain after surgical procedures.

A significant proportion of cases of PPSP may be of neuropathic origin [14,16] Avoiding unnecessary surgical nerve damage by using nerve-sparing surgical techniques may be important elements in preventing chronic pain, although the exact relationship between nerve lesions and the subsequent development of pain remains partly enigmatic [16,21,32]. We hypothesized that nerve lesions might contribute to a significant proportion of the cases with PPSP, and consequently that symptoms consistent with such lesions would be associated with PPSP in the general surgical population. The specific aims of this study were to assess the prevalence of persistent pain after surgery performed during the last 3 years in the general population, and to identify factors associated with PPSP, i.e., demographic, social, psychological, and somatic factors, including self-reported symptoms of nerve injury.

2. Methods

2.1. Study population and sample—the Tromsø study

In 2007–2008, 12,982 of 19,762 invited individuals attended Tromsø VI, the 6th Tromsø study, a cross-sectional survey and medical examination in north Norway [9]. The sample was recruited from 4 different groups, all with postal address in the municipality of Tromsø: (1) all previous attendees in phase 2 of a previous Tromsø study (Tromsø IV, 1994–1995), (2) a 10% random sample of individuals 30 to 39 years old, (3) all inhabitants 40 to 42 years and 60 to 87 years, (4) a 40% random sample of inhabitants 43 to 59 years of age.

Women constituted 53.4% of the attendees, and 51.3% of the invited. Tromsø VI addresses a wide range of health problems, i.e., cardiovascular and cerebrovascular diseases, dermatological, rheumatological, neurological, psychiatric and work-related disorders, osteoporosis, and chronic pain [9].

2.2. Questionnaires

All participants completed 2 questionnaires. The first, a 4-page questionnaire, was distributed together with the invitation and completed before attending the examination. A second, more comprehensive questionnaire was completed either during the visit or later at home and returned by mail.

The first questionnaire included questions regarding general health, presence of diseases, familial diseases, muscular pain, emotional problems, lifestyle factors, education, medication, and consumption of health care. In this questionnaire, the participants were asked if they had undergone surgery during the 3 years preceding the survey. Those who responded positively to this question were asked to complete follow-up questions in the second questionnaire, covering time of surgery, anatomical area of surgery, and present sensory disturbances in close vicinity to the surgical scar. They were asked to rate the maximum pain intensity in the area of surgery with an 11-point numerical rating scale (NRS 0 to 10), where 0 = no pain and 10 = worst pain imaginable. The questionnaire also included NRS ratings of usual pain in the area of surgery, yes/no questions regarding the presence of preoperative pain, and whether the present pain was similar to the preoperative pain or not. Individuals who had gone through more than 1 surgical procedure were instructed to refer to the last operation performed when they answered the questions. A separate section of the questionnaire included questions on chronic pain of any type, defined as "constant or recurring pain with a duration of three - months or more" [39].

2.3. Definition of persistent postsurgical pain

We considered PPSP as present when the following were fulfilled: (1) surgery 3 to 36 months prior to the survey, (2) present pain in the area of surgery with an NRS 0 to 10 rating of 1 or higher.

2.4. Data analysis

Based on NRS ratings, we classified PPSP into 4 severity levels: no pain (NRS = 0), mild pain (NRS 1 to 3), moderate pain (NRS 4 to 6), and severe pain (NRS 7 to 10). Psychological distress, a compound variable containing items of both anxiety and depression, was assessed with the Hopkins Symptom Checklist–10 item version, generating a continuous variable with values ranging from 1.00 to 4.00. The resulting variable was dichotomized, with values exceeding 1.85 categorized as distress [33]. Hypertension was defined as either present systolic blood pressure $\geqslant$140 mm or diastolic blood pressure $\geqslant$90 mm Hg or present antihypertensive medication [22]. Diabetes mellitus was defined as HbA1c $\geqslant$ 6.5% [2]. We performed statistical analyses with cross tables applying χ^2 tests for categorical variables, 2-tailed t tests, and analysis of variance for comparisons of means, Wilcoxon rank-sum test and linear regression for comparison of ordinal data, and logistic regression for assessments of associations between PPSP and independent variables. Backward elimination was performed in multiple logistic regression analysis. Results from logistic regression analyses are reported in odds ratios (OR) with 95% confidence intervals (CI). All data analyses were performed with Stata 12 Statistical Data Analysis statistical program (StataCorp, College Station, TX).

2.5. Ethics

The Regional Ethics Committee and the Norwegian Social Sciences Data Services approved the study protocol. Written consent was obtained from the participants before entering the study.

3. Results

3.1. Sample, response rate, and nonresponders

Invitations were submitted to 19,762 inhabitants of Tromsø. Of these, 12,982 individuals responded and filled in the first questionnaire, yielding a response rate of 65.7%. During the preceding 3 years, 3111 individuals (24.0%) had undergone 1 or more surgical procedures. We obtained complete data on time from surgery (years and/or months) and pain (NRS 0 to 10 ratings) from 2216 participants. Individuals who had gone through surgery fewer than 3 months earlier (N = 173) were excluded, leaving 2043 participants for our analysis (Fig. 1).

3.2. Demographics

The distribution of age and gender among responders and nonresponders is published elsewhere [39]. In our surgical sample, women constituted 52.1% (N = 1064 of 2043), and the mean age was 57.0 years (Table 1). Women who had undergone surgery were on average 1 year younger than the nonsurgery women, whereas the opposite was true for men. Chronic pain was reported more frequently among the surgery than the nonsurgery patients (P = .001), as was the prevalence of psychological distress (P = .018).

Fig. 1. Inclusion.

3.3. Prevalence of persistent postsurgical pain

Pain in the area of surgery (NRS 1 or higher) was reported by 40.4%; 22.2% had mild pain, 11.7% moderate pain, and 6.6% severe pain (Table 2). The prevalence of PPSP differed considerably between the anatomical locations of surgery, ranging from 63.4% (hip, lower extremity) to 20.3% (abdomen, pelvic organs); see Table 3 for details.

3.4. Persistent postsurgical pain vs preoperative pain

Among the surgery patients, 61.6% (N = 1258 of 2043) reported local pain in the area of surgery before surgery (NRS = 1 or higher). The participants were asked, "If you had pain at the site of surgery before you had surgery, do you have the same kind of pain now?", and 74.1% of the individuals with PPSP replied "No". Limiting the analysis to only these individuals, presuming that the others' pain might represent a prolongation of presurgical pain, would leave 10.5% (N = 214 of 2043) with moderate or severe PPSP, as opposed to 18.3% (N = 373 of 2043) before the limitation. Total absence of preoperative pain in the anatomical area of surgery (NRS = 0) was reported by 37.8% (N = 773). In this group, 6.2% (N = 48 of 773) reported moderate or severe postsurgical pain.

3.5. Sensory abnormalities

In the present study, 24.5% (N = 501) reported sensory changes such as hypoesthesia, hyperesthesia, or both in an area near the surgical scar. Hypoesthesia was most common, and was reported by 18.3% (N = 374) overall, and by 23.6% after surgery on hip/lower extremities. Three of 7 individuals who had undergone lung surgery reported hypoesthesia. Except for this procedure, in which the numbers were too small to make meaningful prevalence estimates, the highest prevalence of hypoesthesia appeared after surgery on foot or ankle (34%), breasts (33%), and hand (32%). We found the lowest prevalence of hypoesthesia after surgery on urinary tract and reproductive organs (6%), and gall bladder and biliary tract (5%) (Table 3).

Table 1
General description of participants.

		No surgery last 36 months 82.6% (N = 9846)	Surgery 3 to 36 months before survey* 17.2% (N = 2043)	*P* value
Female, % (n)		53.5 (5263)	52.1 (1064)	.258[1]
Age, mean (SD)		57.1 (12.56)	57.0 (12.37)	.808[2]
	Female	57.3 (12.83)	56.3 (12.71)	.022[2]
	Male	56.9 (12.23)	57.8 (11.96)	.030[2]
Body mass index,† mean (SD)		26.8 (4.20)	27.2 (4.48)	<.001[2]
	Female	26.5 (4.56)	26.9 (4.99)	.006[2]
	Male	27.2 (3.72)	27.6 (3.83)	.002[2]
Education above A-level, % (n)		45.8 (4448)	46.8 (947)	.382[1]
	Female	44.2 (2295)	46.6 (489)	.161[1]
	Male	47.6 (2153)	47.1 (458)	.803[1]
Hypertension, % (n)		47.6 (4668)	46.7 (950)	.464[1]
	Female	44.9 (2354)	43.3 (458)	.335[1]
	Male	50.7 (2315)	50.4 (492)	.874[1]
Diabetes,‡ % (n)		5.5 (536)	6.0 (120)	.464[1]
	Female	4.7 (241)	5.5 (58)	.231[1]
	Male	6.5 (295)	6.4 (62)	.876[1]
Chronic pain, all causes, % (n)		31.0 (3,052)	39.1 (796)	.001[1]
	Female	36.6 (1,922)	45.1 (478)	.001[1]
	Male	24.7 (1,130)	32.6 (318)	.001[1]
Psychological distress,§ % (n)		7.9 (744)	9.9 (195)	.003[1]
	Female	9.9 (495)	12.8 (130)	.006[1]
	Male	5.6 (249)	6.8 (65)	.154[1]
Painkillers,‖ % (n)		7.3 (702)	11.1 (221)	.001[1]
	Female	9.6 (488)	15.1 (156)	.001[1]
	Male	4.7 (214)	6.8 (65)	.008[1]

* Not included were individuals reporting surgery >3 years or <3 months before surgery, individuals with missing data regarding pain or regarding time from surgery. Information about surgery were missing in 25 individuals (0.2%).
† Body mass index = weight (kg)/height(m)^2.
‡ Diabetes = HbA1c $\geqslant$6.5%.
§ Psychological distress = Hopkins Symptom Check List – 10 item version >1.85 [31].
‖ Painkillers = taking prescription painkillers at least once during the last 4 weeks.
[1] χ^2.
[2] Two-tailed *t* test.

Table 2
Predictors of persistent post-surgical pain intensity.

	No pain NRS = 0 59.6% (N = 1217)	Mild pain NRS 1–3 22.2% (N = 453)	Moderate pain NRS 3–6 11.7% (N = 238)	Severe pain NRS 7–10 6.6% (N = 135)	Total 100.1%* (N = 2043)	Missing	Significance of trend *P* value
Age (y), mean ± SD	57.5 ± 12.7	56.4 ± 12.00	56.5 ± 12.1	55.6 ± 11.3	57.0 ± 12.4	–	.039†
Body mass index (kg/m^2), mean ± SD	27.0 ± 4.6	27.6 ± 4.2	27.5 ± 4.4	27.4 ± 4.6	27.2 ± 4.5	2	.029†
Time from surgery (mo), mean ± SD	19.2 ± 10.2	18.3 ± 10.7	18.3 ± 10.8	17.1 ± 10.5	18.7 ± 10.4	–	.015†
Female, %	51.9	49.5	53.4	60.7	52.1	–	.412‡
Diabetes, %	6.6	4.7	5.1	5.3	5.9	25	.147‡
Hypertension, %	46.9	48.9	42.6	44.4	46.7	8	.532‡
Psychological distress, %	7.5	9.6	16.0	22.3	9.9	69	<.001‡
Hypoesthesia, %	9.8	26.9	33.8	44.4	18.6	32	<.001‡
Hyperesthesia, %	4.3	22.2	27.4	45.4	13.6	33	<.001‡

NRS = numeric rating scale.
* 100.1% due to rounding.
† Linear regression, pain intensity as independent variable in analysis.
‡ Wilcoxon rank-sum test, pain intensity as dependent variable in analysis.

Among all factors investigated in the present study, we identified the strongest statistical associations between PPSP and the sensory abnormalities (Tables 2 and 4). The associations were stronger for higher intensities of pain, $P_{trend} < .001$ (Table 2). Fig. 2 illustrates the association between sensory abnormalities and mild, moderate, and severe pain in the area of surgery. The coexistence of both hypoesthesia and hyperesthesia in the area of surgery was reported by 7.2% (N = 146). In this group, 51% reported moderate or severe pain. The corresponding figures for moderate or severe PPSP with hyperesthesia alone was 38%, and with hypoesthesia alone was 27%.

The associations between PPSP and hypoesthesia, and PPSP and hyperesthesia, were present also in the subgroup of individuals who reported absence of local pain before surgery. In this subgroup, a comparison of NRS ratings between individuals with and without sensory abnormalities demonstrated a positive association between both hypoesthesia and hyperesthesia and higher pain ratings ($P < .0001$, Wilcoxon rank-sum test).

3.6. Associated demographic, physical, psychological, and social factors

In the adjusted analysis, age, gender, and time from surgery were not significantly associated with postsurgical pain (Table 4). Psychological distress was associated both with the presence of PPSP, OR 1.69 (95% CI 1.22 to 2.36) (Table 4), and with the intensity of PPSP, $P_{trend} < .001$ (Table 2).

3.7. Persistent postsurgical pain vs chronic pain

In the overall sample, regardless of surgery, 32.7% of the participants (N = 4240 of 12,982) reported having "persistent or constantly recurring pain that has lasted for 3 months or more", in other words, chronic pain. Of these individuals, 6.5% (N = 277) indicated surgery as the cause or one of the causes of their pain. Only 51.0% (N = 421 of 826) of the individuals reporting PPSP answered "Yes" to the question of chronic pain.

4. Discussion

4.1. Main findings

One of the 2 main findings of this study is a high prevalence of PPSP in the area of surgery 3 to 36 months after the surgery was performed. Moderate to severe pain was reported by 18.3% (N = 373 of 2043). These results, derived from a normal population, are in concordance with data from previous studies [14,16,20,26]. The other main finding is the strong association between sensory disturbances and the presence and intensity of postsurgical pain, indicating an important role of nerve damage and possible neuropathic pain in a substantial portion of cases. The association between sensory disturbances and PPSP was statistically significant at the same level in the subgroup without preoperative pain.

4.2. Representativeness

The strengths of this study are the cross-sectional design and the large number of participants. The response rate of 65.7% was high compared with most similar studies, as was the distribution over gender, age, and types of surgery, thus allowing assessments of the burden of PPSP in a general surgical population. To our knowledge, this study is the largest study ever done on the subject of PPSP. Participation was lowest (<50%) in the younger age groups (30 to 39 years) and among the oldest (80 to 87 years) [9]. We consider our findings generalizable to a general Caucasian population.

4.3. Time frame

The participants were asked whether they had undergone surgery during the last 3 years. We chose this time frame to reduce the error due to inaccurate recall. As a consequence, pain caused by earlier surgery was not included in our analysis. Although this certainly leads to underestimation of the overall prevalence of PPSP in the population, it does not necessarily affect our estimate of the prevalence of PPSP among surgical patients, nor the association between PPSP and other measures, such as symptoms of nerve injury.

4.4. Definition and validity of the concept of persistent postsurgical pain

As indicated, the prevalence of PPSP is highly dependent on its definition. Macrae [19] proposed a definition in which exclusion of the possibility that the pain represents a prolongation of the preoperative pain state should be attempted. In a cross-sectional study, the opportunities of doing so are limited. In fact, many of the clinical studies of PPSP cited in this article have not conducted assessments of preoperative pain. We included 2 questions regarding preoperative pain quality and intensity. Excluding individuals indicating the same sort of pain as before surgery results in lower estimates of PPSP. Restricting the analysis to only those who report no preoperative pain gives even lower estimates, yet still leaves 6.2% with moderate to severe PPSP. Limiting the focus to these

Table 3
Areas of surgery and prevalence of post-surgical pain and sensory abnormalities.*

	Pain	Hypoesthesia		Hyperesthesia		
	% (n)	% (n)	Missing	% (n)	Missing	N†
Hip, leg	63.4 (263)	23.6 (98)	12	15.4 (64)	13	415
Hip, thigh	63 (58)	14 (13)	2	15 (14)	3	92
Knee, lower leg	66 (138)	22 (46)	6	12 (26)	7	209
Ankle, foot	59 (67)	34 (38)	4	21 (24)	3	113
Amputation leg, foot	0 (0)	100 (1)	0	0 (0)	0	1
Shoulder, arm	60.9 (162)	20.3 (53)	5	20.1 (53)	2	266
Shoulder, upper arm	72 (84)	7 (9)	2	10 (13)	1	117
Elbow, lower arm	32 (11)	21 (7)	0	15 (5)	1	34
Hand	58 (66)	32 (36)	3	30 (34)	0	114
Amputation arm, hand	100 (1)	100 (1)	0	100 (1)	0	1
Chest	31.0 (67)	21.1 (45)	3	13.7 (29)	4	216
Heart	31 (38)	17 (20)	1	12 (14)	2	122
Lungs	86 (6)	43 (3)	0	29 (2)	0	7
Breasts	31 (18)	33 (19)	1	19 (11)	1	58
Other surgery in chest	17 (5)	11 (3)	1	7 (2)	1	29
Head, neck, back	27.5 (91)	12.4 (41)	1	11.6 (38)	3	331
Head, face	17 (35)	11 (23)	1	11 (22)	3	207
Neck/throat	22 (14)	19 (12)	0	11 (7)	0	63
Back	69 (42)	10 (6)	0	15 (9)	0	61
Stomach, pelvic organs	20.3 (110)	13.2 (71)	4	6.5 (35)	3	541
Stomach, intestines	25 (27)	12 (13)	1	7 (8)	0	108
Inguinal hernia	30 (11)	22 (8)	0	11 (4)	0	37
Urinary tract, reproductive organs	14 (19)	6 (8)	2	6 (8)	2	140
Gall bladder, biliary tract	41 (15)	5 (2)	0	3 (1)	0	37
Other operation in abdomen/ genitalia	17 (38)	18 (40)	1	6 (14)	1	219
Total	39.2 (693)	17.7 (308)	25	12.6 (219)	25	1769

* Sensory abnormalities: self-reported hypoesthesia, hyperesthesia, or both in an area at or close to the operation scar.
† Individuals with more than 1 surgical site in the surgical procedure excluded.

Table 4
Multiple logistic regression: predictors of persistent post-surgical pain (NRS 1 or higher: 826 individuals).

	Crude analysis			Adjusted analysis, psychological distress not included in model			Adjusted analysis, psychological distress included in model		
	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value
Female gender	1.02	0.86–1.22	.799						
Age (10-y intervals)	0.93	0.86–0.99	.034			NS			NS
Hypertension	0.98	0.82–1.17	.800						
Diabetes	0.73	0.49–1.08	.116						
Time from surgery (6-mo intervals)	0.94	0.90–0.99	.027			NS			NS
Body mass index	1.03	1.01–1.05	.004	1.02	1.00–1.05	.033	1.02	1.00–1.05	.049
Psychological distress	1.94	1.44–2.61	<.001				1.69	1.22–2.36	.002
Hypoesthesia	4.29	3.37–5.46	<.001	2.74	2.10–3.56	<.001	2.68	1.05–3.50	<.001
Hyperesthesia	8.51	6.18–11.72	<.001	6.42	4.55–9.05	<.001	6.27	4.43–8.86	<.001

CI = confidence interval; NRS = numeric rating scale; NS = not significant; OR = odds ratio.

subgroups certainly minimizes the risk of reporting prolonged preoperative pain. On the other hand, pain is one of the most frequent indications for medical assistance and surgery, and the majority of our sample reported pain before surgery. Leaving out individuals who had preoperative pain and later developed subsequent pain due to surgery may lead to considerable underestimations of PPSP. Furthermore, the questions of preoperative pain quality and intensity are retrospective in nature, and as such are subject to recall error, possibly influenced by present health status [35].

Pain, reported as a number between 0 and 10 when asked about specific body sites, does not necessarily confirm clinically relevant pain. When comparing the responses on the general question "Do you have persistent or constantly recurring pain that has lasted for 3 months or more" and the more specific question about (persistent) "pain in the area of surgery", the answers seem inconsistent: only half of the individuals reporting pain in the area of surgery 3 months or more after surgery reported having chronic pain. This might imply that people may experience localized, persistent pain without perceiving the pain as a relevant pain problem, thus reserving the term "persistent pain" or "chronic pain" for the latter. If this is the case, it might have implications for the assessment of pain in studies of postsurgical pain, questioning whether some of the reports indicating an alarming prevalence of postsurgical pain may include cases of less clinical relevance.

These problems of preoperative pain, retrospective vs real time reporting, and specificity of questions highlight some of the obstacles in gathering precise and relevant data on chronic pain in a population. Taking the above considerations into account, we have regarded the question of present pain intensity in the area of surgery as valid, and used this as basis for the analyses presented in this article, referring to other pain variables for supplementary data when appropriate.

4.5. Heterogeneity of sample

The present study describes PPSP after several common surgical procedures. The sample is heterogeneous. The participants were asked to report any surgery and to indicate the operative area. Both

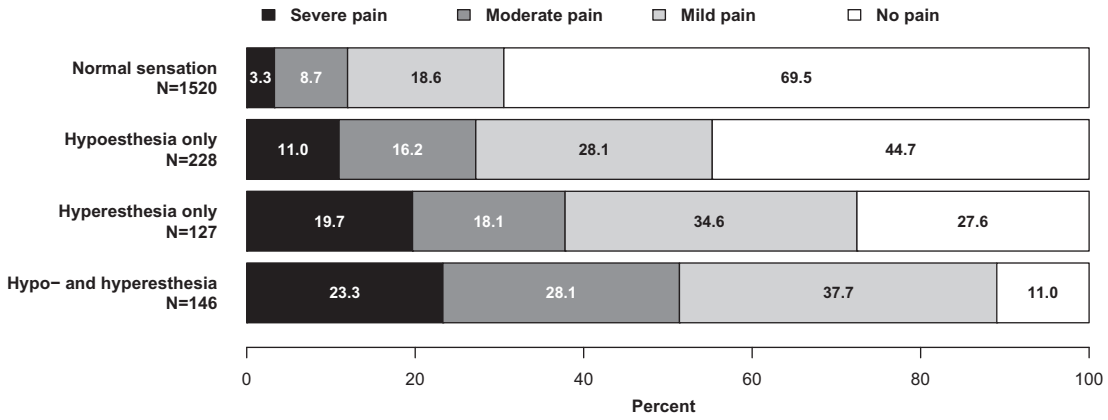

Fig. 2. Sensory abnormalities and persistent post-surgical pain in anatomical area of surgery. Numbers inside cells are percentages.

small and extensive surgical procedures were included. This heterogeneity may weaken statistical associations and hamper the search for specific factors. On the other hand, statistical associations in such a heterogeneous sample may point to mechanisms or causal relationships with clinical relevance beyond specific surgical procedures.

4.6. Pain and sensory abnormalities

The most striking finding in this study is the strong association between pain and sensory disturbances in the area of surgery (Fig. 2). There is a positive statistical association between both hypoesthesia and hyperesthesia and increasing intensities of pain (Table 2). Hypoesthesia is a symptom of nerve damage, whereas hyperesthesia indicates sensitization. Localized coexistence of decreased nerve function and increased sensitivity for certain stimuli is sometimes a prominent feature of neuropathic pain [8]. In this study, the prevalence of moderate or severe PPSP was 51% among individuals with self-reported simultaneous hypoesthesia and hyperesthesia in the area of surgery (Fig. 2). Pain intensity was statistically associated with the presence of sensory disturbances also in the subgroup with absence of preoperative pain (see Section 3.5). Although the majority of participants with PPSP did not report symptoms of nerve injury, this finding points to nerve damage as a possible important factor for persistent postsurgical pain and thus neuropathic pain in a significant proportion of cases, particularly in cases with moderate to severe pain.

4.7. Different surgical procedures, pain, and sensory abnormalities

We found a high variability in the prevalence of pain and sensory disturbances between different anatomical areas of surgery (Table 3). Except for lung surgery, pain was most frequently reported after surgery on the back and extremities. Orthopedic, spinal, and hand surgery are often performed because of pain, and prolongation of the preoperative pain may confound the result. Sensory abnormalities were most frequently reported after surgery to the lungs, ankle/foot, breasts, and hand.

4.8. Demographic factors

We did not identify statistically significant associations between gender, age, and PPSP. Although female gender is cited as a risk factor for PPSP in several reviews [14,16,26], results are not conclusive. References are sometimes made to studies of acute postoperative pain [11,36], and sometimes even to gender-specific surgical procedures [13,29]. A large, prospective study by Peters et al. including a variety of different surgical procedures did not identify gender as a risk factor [27]. Other studies have, however, demonstrated an increased risk for PPSP among women after knee arthroscopy [31] and cholecystectomy [24].

In our study, the proportion of invited individuals varied between age cohorts, from 10% to 100%. Both the sampling rate and the response rate were lowest for the youngest cohort, limiting the effective age to 40 years and up. This might possibly have attenuated associations between age and PPSP in our analysis.

4.9. Psychosocial factors

Although the cross-sectional design of the present study does not allow inferences about the direction of causality, the strong association between psychological distress and PPSP adds to the pool of evidence indicating links between PPSP and depression. Although depression, fear of surgery [27], psychic vulnerability [10], and catastrophizing [27] have been shown to be associated with established PPSP, fear of surgery and psychic vulnerability have also been identified as predicative for PPSP when assessed preoperatively, and preoperative optimism may be indicative of a favorable outcome [27].

As described by Jacobsen et al. [9], the Tromsø study is a series of cross-sectional surveys, and cohorts are followed up over time. In 2007–2008, pain research was included for the first time. Repeated surveys in the years to come may allow analyses of temporal relations between somatic, psychological and social factors, surgery, and PPSP.

4.10. Conclusions

The present cross-sectional survey documents that persistent pain after surgery is common. Three months or more after surgery, 40.4% reported pain. Moderate or severe pain was reported by 18.3%. A majority of patients had pain before surgery. Only 51% of those who reported PPSP considered themselves to have chronic pain. Sensory disturbances in the area of surgery showed a strikingly strong association with PPSP, suggesting nerve damage as a contributing factor in a significant portion of cases.

Conflict of interest statement

The authors have no conflicts of interest related to this work.

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