Retrospective Review

Pain-Related Limitations in Daily Activities Following Thoracic Surgery in a United States Population

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Background: Ringsted et al created a statistically validated questionnaire to assess pain-related limitations in daily activities following thoracic surgery and translated it to English. We utilized the questionnaire to assess the impact of pain impairing certain daily activities in a United States thoracic surgery population.

Objectives: Examine if the questionnaire developed and translated to English by Ringsted et al to assess the effects of chronic pain after thoracic surgery on daily activities would be applicable in a sample of thoracic surgery patients in the United States.

Study Design: Cross-sectional study by mailed questionnaire.

Setting: All patients who had thoracic surgery between 6 months and 3 years ago at a university hospital.

Methods: We sent questionnaires to patients who had undergone thoracic surgery between 6 months and 3 years ago, yielding a sample of 349 eligible patients. Questionnaire results were statistically assessed for item fit, dimensionality, and internal reliability.

Results: The response rate was 26.4%. Of the responders, 36% (95% CI: 26.1% to 46.5%) identified themselves as having chronic pain related to their thoracic surgery. Activities such as lying on the operated side, coughing, and carrying groceries were impaired in more than 50% of the patients who had thoracic surgery related pain ($P < 0.05$). Patients with chronic pain were more likely to report pain in other body locations. Few activities were limited in the patients identifying themselves as not having chronic pain. Statistical measures indicate high internal reliability.

Limitations: This was a retrospective questionnaire with 26.4% response rate.

Conclusions: Pain continues to impair the daily activities of a significant proportion of patients after thoracic surgery in a sample from the United States. Despite cultural differences, the Danish procedure-specific questionnaire provides an applicable and similar assessment of functional impairment after thoracic surgery in American patients.

Key words: Thoracic surgery, chronic pain, impairment, daily life, questionnaire

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Acute post-surgical pain affects most patients who undergo thoracic surgery. For many, pain after thoracic surgery subsides in the days to weeks following their procedure. However, in approximately 50% of thoracic surgery patients, pain persists for months after their procedure and is referred to as chronic post-surgical pain (1-3). Although there are varied definitions for chronic pain after surgery, chronic pain can be determined either 3 or 6 months after the surgery (1,4). In this study, we contacted patients 6 months to 3 years after their thoracic surgery. The effects of chronic pain after thoracic surgery on patients' daily activities are not well examined (5-8). The Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) group suggested guidelines for the development of validated, operation-specific questionnaires for post-surgical patients (9). Following guidelines from the IMMPACT group, Ringsted et al (10) created a questionnaire to assess pain-related limitations in daily activities following thoracic surgery. The questionnaire was unidimensional, had high reliability (between 0.88 and 0.96), was statistically validated using patients from Denmark, and was translated to English by Ringsted et al (10). Therefore, the questionnaire by Ringsted et al (10) was superior to existing instruments for assessing functional difficulties after thoracic surgery.

Because of differences in the cultural norms and lifestyle of Danish people, certain questions may be more or less applicable to patients who undergo thoracic surgery in the United States. For example, impairment while driving a car may be more relevant to an American patient than a Danish patient. The primary aim of this study was to examine whether the questionnaire developed and translated to English by Ringsted et al (10) to assess the effects of chronic pain after thoracic surgery on daily activities would be applicable in a sample of thoracic surgery patients in the United States.

Methods

Participants

The study was approved by the University of Iowa Institutional Review Board (IRB) (IRB #: 201412805, Iowa City, IA). We identified patients who had thoracotomy or video-assisted thoracoscopic surgery (VATS) in the past 6 months to 3 years at the time of the mailing at the University of Iowa Hospitals and Clinics using electronic medical records. Those patients who underwent thoracic surgery with CPT codes of 32100, 32440, 32480, 32482, 32484, 32486, 32488, 32500, 32651, 32655, 32657, 32663, and 32666 were identified. There were 2 batches of mailings. The first batch represents those patients who underwent thoracic surgery between January 15, 2012, and June 15, 2014, and the second batch represents those patients who had surgery between June 16, 2014, and January 15, 2015. The combined query returned 432 eligible patients, 357 patients from the first group (January 2012 to June 2014) and 75 patients from the second (June 2014 to January 2015). Of these, 16 patients were not eligible (prisoner, age < 18 years) and 67 were deceased (Fig. 1). Mailings were sent to 349 living, eligible patients. Patients received a cover letter including information about the study, an informed consent form, a questionnaire, and a stamped and addressed envelope to return their response. Overall, 92 patients (26.4%) completed the questionnaire, 94 (26.9%) declined to participate, 17 (4.8%) forms were undeliverable, and 146 (41.8%) patients were nonresponders (Fig. 1).

Information from electronic medical records from 92 responders was compared to 146 nonresponders to assess if responders were representative to the thoracic surgery population from the University of Iowa. Those 94 patients who declined to participate were not included in this comparison.

Presence of Chronic Pain

Patients were categorized as having chronic pain after thoracic surgery based on their response to the following question: "Do you currently have pain related to your thoracic surgery?" The average pain intensity during the previous week, among those patients with pain, was quantified with the numerical rating scale (NRS, 0 – 10).

Other Measures

We examined information from patients' medical records including age, gender, American Society of Anesthesiologists physical status (ASA PS), the type and duration of surgery, number of chest tubes during the first 3 days after surgery, and radiation and chemotherapy within 2 months of surgery. Our usual care for patients undergoing VATS is patient controlled analgesia using hydromorphone or morphine until patients tolerate oral nutrition and medications. For open thoracotomy, unless contraindicated, a thoracic epidural catheter was placed at T5-T6, an infusion of 0.05% or 0.10% bupivacaine was infused at 8 – 14 mL per hour as tolerated, based on blood pressure and pain scores (11). Patient controlled analgesia was utilized for rescue as above. If converted from VATS to open thoracotomy, a patient was given patient controlled analgesia and offered thoracic epidural analgesia in the recovery room or on postoperative day one.

Because studies with other chronic pain conditions suggest pain in other body regions may be a risk factor for chronic pain after surgery (12), the presence of pain in other body areas (headache, back, abdominal, hip, knee, other) was queried (10). If present, the associated intensity of pain in these other areas was also quantified (NRS, 0 – 10).

Danish Thoracic Surgery Questionnaire

Ringsted et al's (10) questionnaire included 17 items, which assessed pain with certain daily activities. Participants had 6 choices for each question: "I never perform the activity due to pain," "I never perform the activity," "pain impairs me a lot," "pain impairs me somewhat," "pain impairs me a little," and "pain does not impair me." The questionnaire by Ringsted et al (10) is shown in Supplementary Table 1.

For the Danish cohort, Ringsted et al (10) observed that 4 out of 17 items ("running," "cycling," "swimming," and "driving a car") had too many responses of "never perform" and therefore they excluded those items from the cumulative pain impairment score. For our survey, these 4 items had few responses of "never perform" (n_{run} = 38, n_{cycle} = 35, n_{swim} = 32, $n_{driving}$ = 7) and thus were included in our results. The cumulative pain impairment score was calculated as the sum of the scores for all 17 items. A second analysis was based on 13 items to compare our results in the United States to the Danish study.

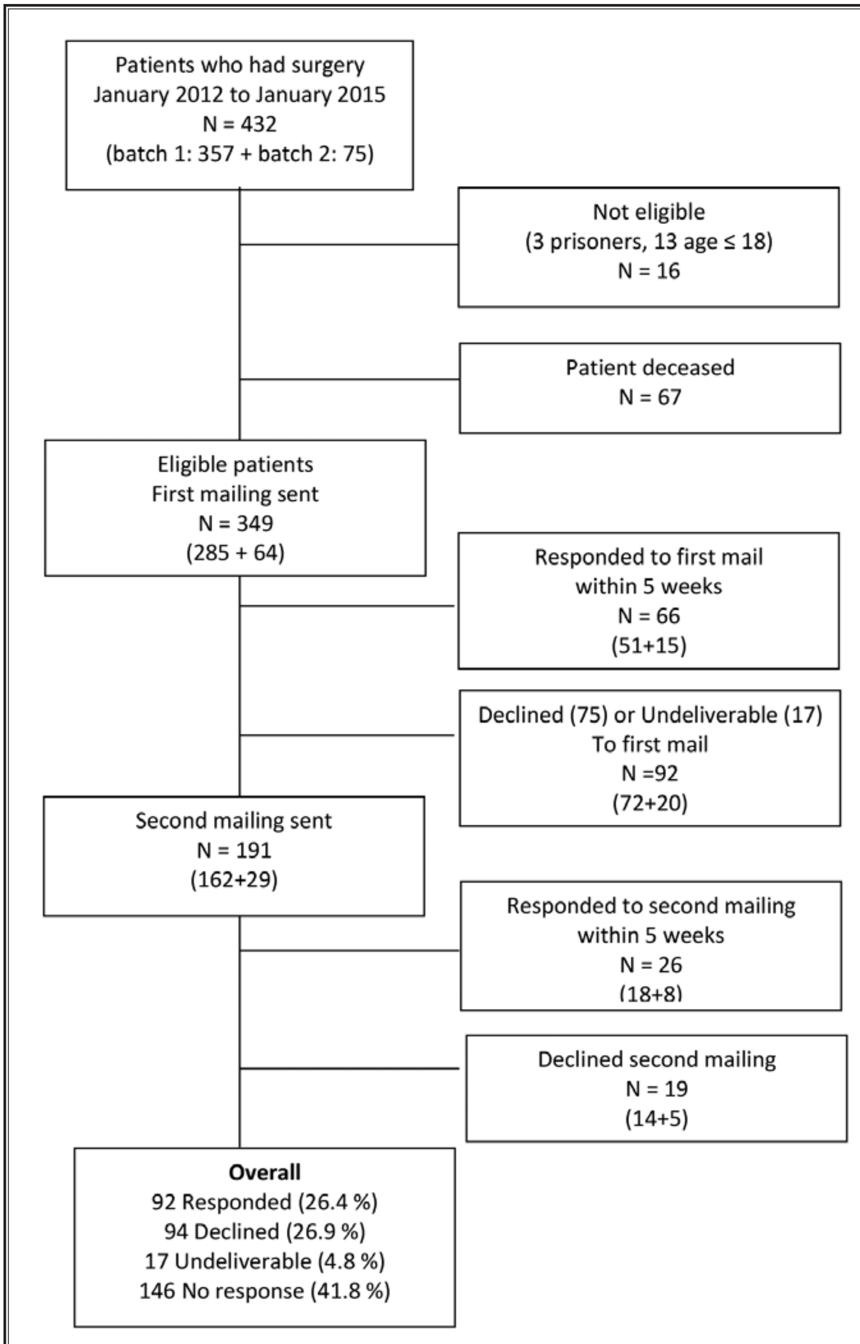

Fig. 1. *Flowchart for the eligible and enrolled patients. There were 2 batches of mailings. Batch 1 represents those patients who underwent thoracic surgery between January 15, 2012, and June 15, 2014, and the batch 2 who had surgery between June 16, 2014, and January 15, 2015. The "+" sign separates the 2 batches.*

Statistical Methods

The normality of the continuous data was statistically tested by the Shapiro Wilk test and by examining the quantile-quantile plot. Normally distributed continuous variables were presented as mean ± standard deviation (SD) and compared using

Table 1. *Demographic, pre-operative, and intra-operative information for responders vs nonresponders.*

	Responders (n = 92)	Nonresponders (n = 146)	*P*-value
Age at surgery, mean ± SD	59.0 ± 17.2	54.5 ± 14.7	0.04
Gender male %	47 (51.1%)	66 (45.2%)	0.38
ASA physical status before surgery			
I II III IV	2 (2.17%) 25 (27.2%) 60 (65.2%) 5 (5.4%)	0 (0%) 45 (30.8%) 87 (59.6%) 14 (9.6%)	0.20
Type of surgery			
VATS Conversion Thoracotomy	71 (77.2%) 5 (5.43%) 16 (17.4%)	107 (73.3%) 14 (9.6%) 25 (17.1%)	0.51
Duration of surgery, minutes, median (Q_{25}, Q_{75})	93.0 (54.0, 161.5)	108.0 (61.0, 169.0)	0.39
Number of chest tubes on day 1			
1 2 ≥ 3	85 (92.4%) 7 (7.6%) 0 (0%)	121 (82.9%) 22 (15.1%) 3 (2.1%)	0.09
Number of chest tubes on day 2			
0 1 2 ≥ 3	21 (22.8%) 64 (69.6%) 7 (7.6%) 0 (0%)	42 (28.8%) 81 (55.5%) 20 (13.7%) 3 (2.1%)	0.10
Number of chest tubes on day 3			
0 1 2 ≥ 3	38 (41.3%) 47 (51.1%) 7 (7.6%) 0 (0%)	71 (48.6%) 56 (38.4%) 16 (11.0%) 3 (2.1%)	0.18
Radiation therapy within 2 months of surgery	1 (1.1%)	4 (2.7%)	0.65
Chemotherapy within 2 months of surgery	8 (8.7%)	16 (11.0%)	0.57
Patient diagnosed with lung cancer	39 (42.4%)	63 (43.2%)	0.91
Surgeon			
Surgeon #1 Surgeon #2 Surgeon #3 Other	37 (40.2%) 27 (29.4%) 23 (25.0%) 5 (5.4%)	49 (33.6%) 42 (28.8%) 34 (23.3%) 21 (14.4)	0.18
Patient received epidural at the time of surgery	30 (32.6%)	52 (35.6%)	0.63
Months from surgery to initial survey sent date, median (Q_{25}, Q_{75})	15.7 (11.2, 25.1)	16.9 (10.7, 27.8)	0.51

SD: standard deviation, Q_{25}: 25th percentile, Q_{75}: 75th percentile, ASA: American Society of Anesthesiologists, VATS: video-assisted thoracoscopic surgery.

a 2-sample t test. When the distribution is not normal, median along with first (Q_{25}) and third quartiles (Q_{75}) were presented and the groups were compared using a Wilcoxon rank sum test. Categorical data were presented as frequency and percentage, and were statistically tested using the chi-square test or the Fisher's exact test, where appropriate. Two-sided 95% confidence interval (CI) for the incidence of thoracic surgery related pain was calculated according to Clopper and Pearson (13). Since many patients' cumulative pain impairment scores were zero, patients with and without chronic pain were compared based on the zero-inflated Poisson model (14).

The fit of the items, prepared for Danish thoracic surgery patients compared to the American patients, was assessed by the pathway plot of the standardized infit mean squares vs the difficulty estimates of the measures. Activity difficulty estimates were presented both on the logit scale and on the probability scale. For example, activities with difficulty estimates of -1, 0, and 1 logits correspond to probability estimates of being painful to perform 27%, 50%, and 73% of the time, respectively. More painful to perform activities were presented closer to the top and less painful items towards the bottom in this plot. The sizes of the bubbles are proportional to the standard error estimates. The standardized infit statistics (x-axis) represent the amount of misfit, and are expected to change between -2 and +2 for fitting items (15).

Like Ringsted et al (10), we performed exploratory factor analysis. As a measure of scale reliability and measure of internal consistency, the Cronbach alpha coefficient was calculated (16). The concurrent validity was assessed by examining the Spearman rank correlation coefficients of the average severity of the pain score and the cumulative pain impairment score. The association between the presence of pain and the cumulative pain impairment score was quantified by the Goodman & Kruskal γ coefficient (17) and presented as a measure of criterion validity.

Basic data analyses were performed by using SAS software (SAS 9.3, SAS Institute Inc, Cary, NC). Winsteps® 3.91.0 Rasch measurement computer program (Beaverton, Oregon) (18) was used for the Rasch model analyses. Plots were created using R version 3.0.0 (The R Foundation, Vienna, Austria) (19).

Results

Participants

Ninety-two patients (26.4%) completed the questionnaire, 94 (26.9%) declined to participate, and 17 (4.8%) forms were undeliverable. One hundred and forty-six (41.8%) patients were nonresponders (Fig. 1). Data from electronic medical records were compared for 92 responders vs 146 nonresponders (Table 1). The nonresponders tended to be younger (54.5 ± 14.7) at the time of surgery, compared to responders (59.0 ± 17.2, $P = 0.04$). Other demographic or intra-operative variables were similar for both groups of patients.

Demographic, Pre-operative, and Intra-operative Information for Responders

In response to our question, “do you have pain related to thoracic surgery,” 33 of 92 (35.9%, 95% CI: 26.1% to 46.5%) responders answered “yes.” Demographic information for those patients who identified themselves as having chronic pain and those that did not have chronic pain is presented in Table 2. The average NRS (0 – 10) for those 33 patients with chronic pain was 4.00 ± 2.15.

The median time from surgery to completion of the questionnaire was 15.7 months (Q_{25}: 11.2, Q_{75}: 25.1). The average age at the time of surgery was 59.0 ± 17.2, and 51% of the patients were male. All but 5 of the surgeries were performed by 3 surgeons. The majority of the patients had VATS (n = 71, 77.2%). Five patients were converted from VATS to thoracotomy. These patients were included in the thoracotomy group in Table 2. Patient demographics and intra-operative care were similar for both groups of patients with and without chronic pain.

Consequences of Thoracic Surgery on Daily Activities

We divided the patients’ survey results into those who identified themselves as having chronic pain related to thoracic surgery (n = 33) and those that did not (n = 59). The effects of pain after thoracic surgery on 17 daily activities are summarized for those 2 groups in Fig. 2.

For chronic postsurgical pain patients, activities impaired by postsurgical pain (Fig. 2, top) in more than 50% (lower confidence bound > 50%) of the patients were lying on the operated side (72.7% [54.5% to 86.7%]), carrying groceries (75.8% [57.7% to 88.9%]), sleeping (81.8% [95% CI: 64.5% to 93.0%]), coughing (81.8% [64.5% to 93.0%]), and getting out of bed (100% [89.4% to 100%]). Watching TV (39.4% [22.9% to 57.9%]) was an exception, impaired in less than 60% (upper confidence bound < 60%) of chronic postsurgical pain patients.

In patients that did not have chronic pain after thoracic surgery, a few patients noted impaired activities related to pain such as carrying groceries (23.7% [13.6% to 36.6%]), sleeping (15.3% [7.2% to 27%]), and ascending stairs (16.9% [7.4% to 29%]).

Item Difficulty and Fit Statistics

For all patients completing the survey (n = 92), a pathway plot was created for activities. In the pathway plot (Fig. 3), more painful to perform activities are presented towards the top and less painful activities towards the bottom. For all patients, regardless of chronic postsurgical pain status, the easiest to perform activities were watching TV, sitting, and driving. Pain

Table 2. *Demographic, pre-operative, and intra-operative information for patients with and without chronic thoracic surgery related pain.*

	Patients with chronic pain (n = 33)	Patients without chronic pain (n = 59)	*P*-value
Age at surgery, mean ± SD	60.2 ± 12.2	58.4 ± 19.5	0.59
Gender male %	16 (48.5%)	31 (52.5)	0.71
ASA physical status before surgery			
I	0 (0.0%)	2 (3.4%)	0.11
II	10 (30.3%)	15 (25.4%)	
III	19 (57.6%)	41 (69.5%)	
IV	4 (12.1%)	1 (1.7%)	
Type of surgery			
Thoracotomy	8 (24.2%)	13 (22.0%)	1.0
VATS	25 (75.8%)	46 (78.0%)	
Duration of surgery, minutes, median (Q25, Q75)	86.0 (44.0, 180.0)	110.0 (61.0, 157.0)	0.81
Number of chest tubes on day 1			
1	30 (90.9%)	55 (93.2%)	0.70
2	3 (9.1%)	4 (6.8%)	
Number of chest tubes on day 2			
0	8 (24.2%)	13 (22.0%)	0.82
1	22 (66.7%)	42 (71.2%)	
2	3 (9.1%)	4 (6.8%)	
Number of chest tubes on day 3			
0	13 (39.4%)	25 (42.4%)	0.95
1	17 (51.5%)	30 (50.8%)	
2	3 (9.1%)	4 (6.8%)	
Radiation therapy within 2 months of surgery	1 (13.0%)	0 (0.0%)	NA
Chemotherapy within 2 months of surgery	3 (9.1%)	5 (8.5%)	1.0
Patient diagnosed with lung cancer	16 (48.5%)	23 (39.0)	0.38
Surgeon			
Surgeon #1	14 (42.4%)	23 (39.0)	0.70
Surgeon #2	8 (24.4%)	19 (32.2)	
Surgeon #3	10 (30.3%)	13 (22.0)	
Other	1 (3.0%)	4 (6.8)	
Patient received epidural at the time of surgery	9 (27.3%)	21 (35.6%)	0.41
Months from surgery to survey, median (Q_{25}, Q_{75})	14.8 (10.1, 26.7)	17.4 (11.3, 24.9)	0.54
Intensity of pain related to thoracic surgery	4.0 ± 2.15	NA	NA

SD: standard deviation, Q_{25}: 25th percentile, Q_{75}: 75th percentile, ASA: American Society of Anesthesiologists, VATS: video-assisted thoracoscopic surgery.

affected patients more often when they were carrying groceries and heavy bags or ascending stairs, compared to watching TV. Except for running, cycling, and swimming, all the activities' difficulty levels were around or below the 0 logit line (y-axis). This indicates that a person with an ability estimate of 0 logit after the thoracic surgery will have approximately a 50% probability of performing activities near the 0 logit without pain (such as sleeping and lying on the operated side). For those activities below the 0 logit line (such as getting out of bed or driving a car), that same person will have a greater than 50% chance of performing those activities without pain interfering with that activity. Running, cycling, and swimming were well above the 0 logit line, thus, more painful to perform compared to other activities.

Exploratory Factor Analysis

Similar to Ringsted et al (10), we performed exploratory factor analysis and identified evidence for

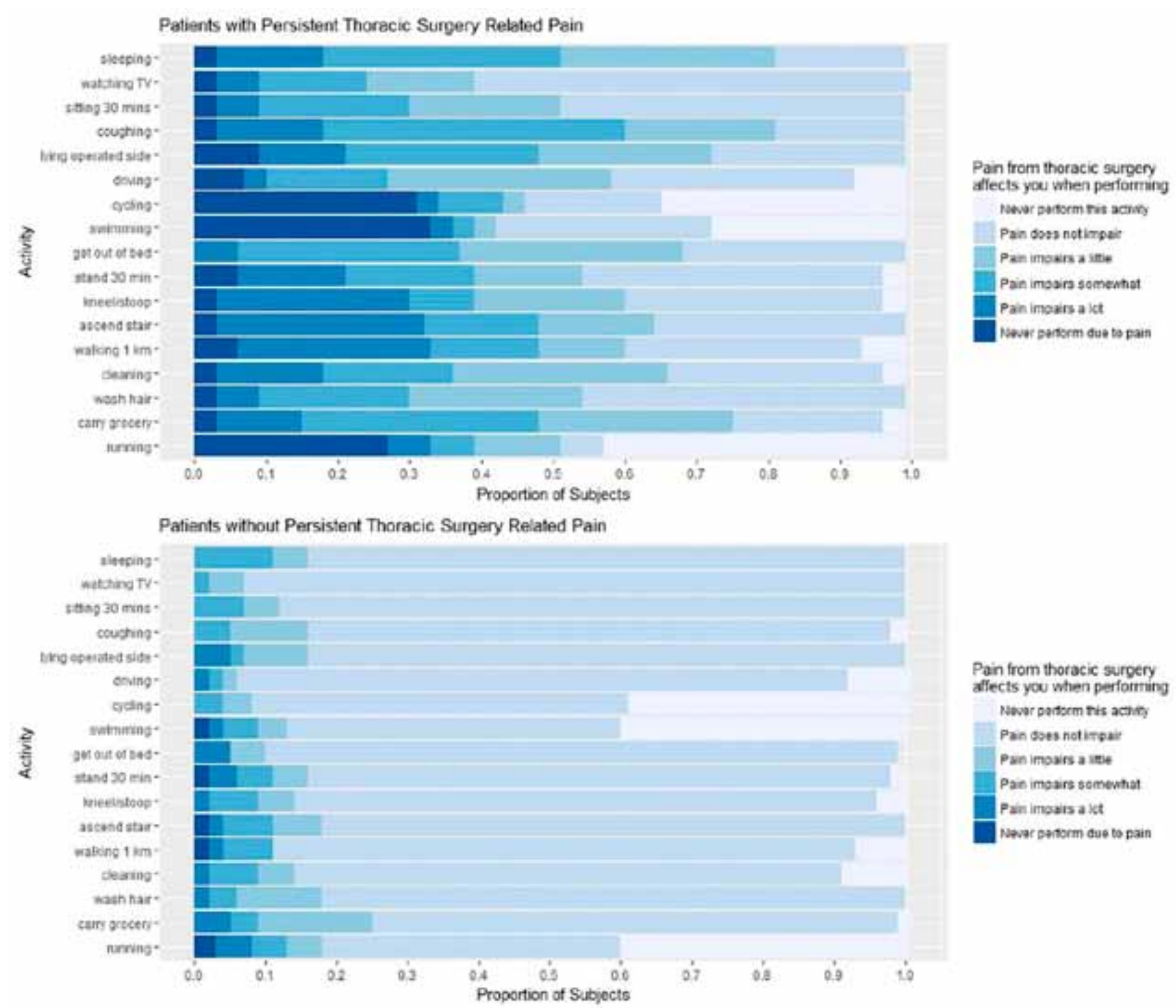

Fig. 2. *Stacked bar chart for the effect of thoracic surgery related pain on daily activities. The top figure represents patients with persistent thoracic surgery related pain (n = 33) and the bottom figure is for patients with no such pain (n = 59).*

2 pain dimensions. The first dimension consolidated "ascending stairs," "walking 1 km," "standing for 30 minutes," "stooping or kneeling," and "running" items. The second dimension included "sitting in a chair for 30 minutes," "watching TV," "swimming," "cycling," "getting out of bed," "driving," and "sleeping." Ringsted et al (10) did not include running, swimming, cycling, and driving in their final report but reported similar items in their 2 dimensions. They named these 2 dimensions as "pain related to mobility" and "pain related to activities of daily life," respectively. Based on our factor analysis, the questionnaire explained 86.5% of the subject variance in our study. The factor analysis of the residuals indicated a small, unexplained variance for 3.6% for the first pain dimension and 3.0% for the second pain dimension.

Cumulative Pain Impairment Score

Ringsted et al (10) showed the validity of the cumulative pain impairment score. In our study, based on all 17 items, the median cumulative pain impairment score was 0.0 (Q_{25}: 0.0, Q_{75}: 3.0) for those patients who

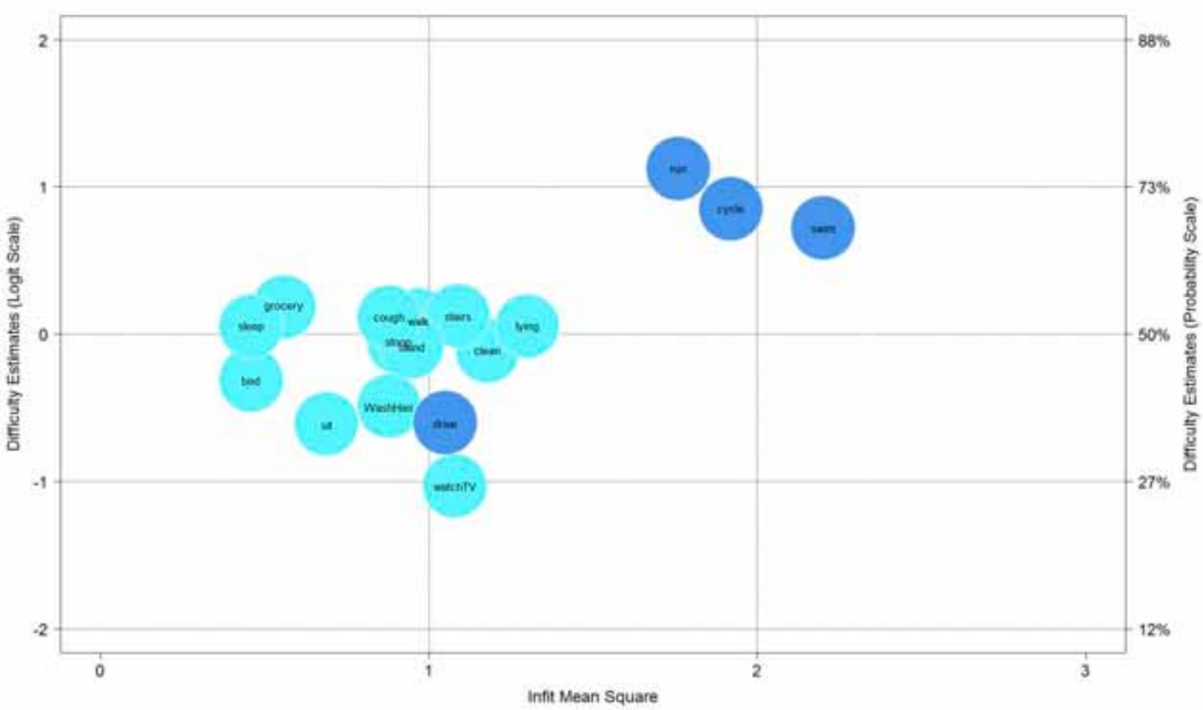

Fig. 3. *Item pathway plot for responders (n = 92). The infit mean square (x-axis) is used for item misfit, where the most mis-fitting items are plotted on the outside of the -2 and +2 area. The y-axis on the left-hand side represents the difficulty measures on the logit scale. Corresponding difficulty estimates on the probability scale are presented on the y-axis on the right side of the figure. Activities thoracic surgery pain impairs the least (watching TV, sitting in a chair) are presented towards the bottom of the plot and activities pain impairs the most (running, cycling) are towards the top of the plot. Note that, the Likert scale rating ("I never perform the activity due to pain," "pain impairs me a lot," "pain impairs me somewhat," "pain impairs me a little," and "pain does not impair me") was used to create this plot. The 4 items that Ringsted et al (10) excluded from the cumulative pain scale are presented in darker blue.*
It should be noted that, this is not a standardized residual contrast plot, therefore, the items in each pain dimension are not necessarily positioned together.

identified themselves as not having chronic pain after thoracic surgery, and was 20 (Q_{25}: 10.0, Q_{75}: 32.0) for those patients who identified themselves as having chronic postsurgical pain (*P* < 0.0001). The distribution of cumulative pain impairment scores based on 17 items are presented in Fig. 4. Results were similar for the cumulative pain impairment score based on 13 items; the median scores were 16 (Q_{25}: 7.0, Q75: 25.0) and 0.0 (Q_{25}: 0.0, Q_{75}: 2.0) for those with and without chronic thoracic surgery related pain, respectively (*P* < 0.0001).

Pain in Other Body Areas

Patients with chronic pain after thoracic surgery more often reported pain in other areas of the body (78.1%), compared to those patients without chronic pain (45.8%, *P* = 0.0015). The presence and intensity of pain in other body locations is presented in Table 3. Both patients with and without chronic pain most frequently reported having pain in their back (53% vs 29%, respectively). The incidences of back pain (*P* = 0.022) and headache (*P* = 0.012) were greater for those patients with chronic thoracic surgery related pain compared to those patients without such pain. The NRSs for pain in other locations were not different between those patients with and without chronic thoracic surgery related pain.

Validity

The concurrent validity was assessed by the Spear-

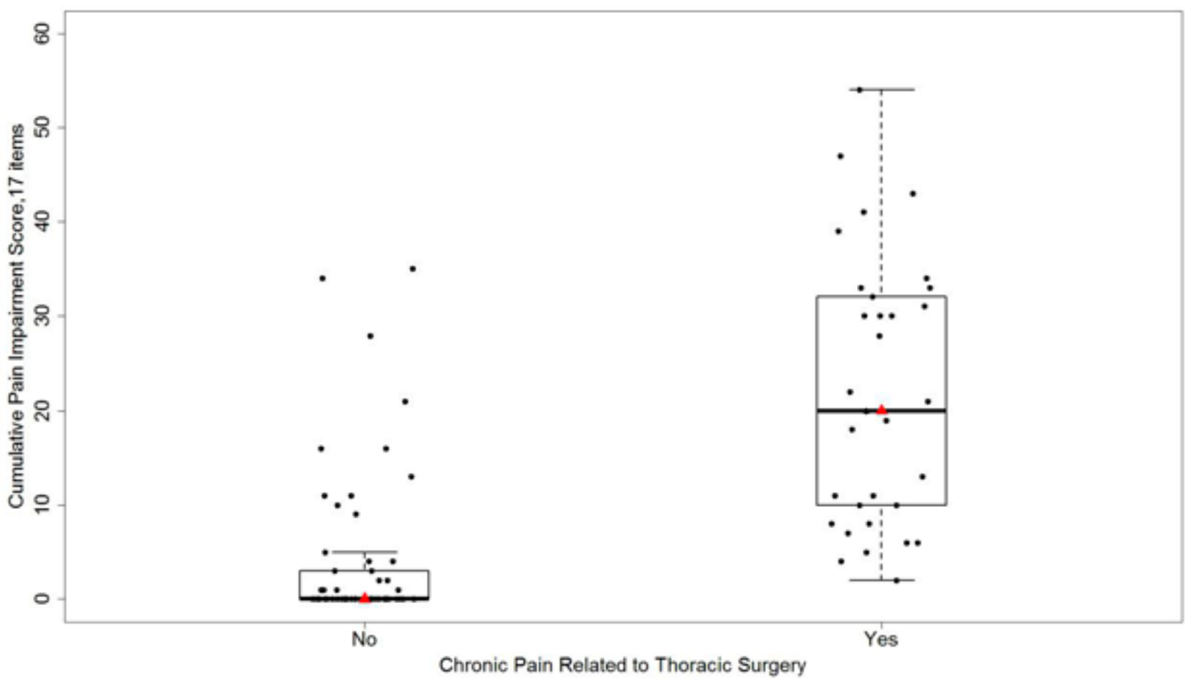

Fig. 4. *Boxplot of cumulative pain scores based on 17 items for those patients with and without persistent pain at the time of the survey. Triangles represent the median cumulative pain scores for those patients with and without persistent pain, separately. The maximum item score of 4 was not obtainable for 4 items measuring daily activities that everyone is required to perform ("washing hair and opening high cupboards," "getting out of bed," "sitting in a chair for 30 minutes," and "sleeping.") Therefore, the maximum cumulative pain impairment score based on 17 items was 64 ([13 x 4] + [4 x 3]). Thirty-four patients (37%) without pain rated all 17 items as "pain not impairing at all," therefore their cumulative pain impairment scores were zero.*

man rank correlation coefficient for each patient's average NRS and their cumulative pain impairment score. The correlations between the patients' average pain score and cumulative pain impairment scores based on both 13 ($r = 0.875$, $P < 0.0001$) and 17 ($r = 0.867$, $P < 0.0001$) items were high.

The criterion validity was assessed by the analysis of the association between the presence of pain (yes/no) at the time of the assessment and the cumulative pain impairment score. The Goodman & Kruskal γ coefficient (17) supports the criterion validity for the cumulative pain impairment scores based on the 13 ($\gamma = 0.804$, $P < 0.0001$) and 17 ($\gamma = 0.817$, $P < 0.0001$) questions. Thus, those patients who identified themselves as having chronic pain after thoracic surgery had higher cumulative pain impairment scores compared to patients with no chronic pain.

Reliability

The Cronbach Alpha person score for the reliability of the questionnaire was 0.97 (95% CI: 0.96 to 0.98) for the American population, and indicates a high internal consistency. The high value of Cronbach Alpha can also be interpreted that some items may be redundant, thus, testing the same information (20).

Discussion

In our survey, we observed that 36% of patients suffer with chronic pain after thoracic surgery, and most daily activities surveyed are affected by pain in these patients. Activities such as lying on the operated side, carrying grocery, sleeping, coughing, and getting out of bed were rated as being impaired by thoracic surgery related pain by more than 50% of the patients who had chronic postsurgical pain after thoracic surgery (*P*

Table 3. *Presence and intensity of pain in other body locations by the patients identifying themselves as having or not having thoracic surgery related pain.*

	Presence of pain (%)			Intensity (NRS, 0-10) Mean ± sd †		
N = 91*	**Patients with chronic pain (n = 33)**	**Patients without chronic pain (n = 58)**	***P*-value for presence ¥**	**Patients with chronic pain (n = 33)**	**Patients without chronic pain (n = 58)**	***P*-value for intensity #**
Pain in other body locations	25 (78.1%)	27 (45.8%)	0.0015	NA	NA	NA
Headache	10 (31.3%)	6 (10.2%)	0.012	3.0 ± 1.8	4.9 ± 2.7	0.15
Back pain	17 (53.1%)	17 (28.9%)	0.022	4.7 ± 2.5	4.8 ± 2.4	0.91
Abdominal	7 (21.9%)	8 (13.6%)	0.31	4.6 ± 2.5	6.6 ± 2.6	0.15
Hip	10 (31.3%)	12 (20.3%)	0.25	4.7 ± 2.4	5.0 ± 2.2	0.81
Knee	11 (34.4%)	14 (23.7%)	0.28	4.4 ± 1.7	5.4 ± 2.4	0.23
Other	10 (31.3%)	12 (20.3%)	0.25	4.2 ± 2.1	5.4 ± 2.3	0.22

*: Note that one patient did not answer this part of the questionnaire, therefore n = 91.
†: Intensities of pain are reported only for those patients with pain.
¥: *P*-value calculated by chi-square test, #: *P*-value calculated by the 2-sample t-test.
NRS: numerical rating scale.

< 0.05). There was heterogeneity in the activities that were impaired; and running, cycling, and swimming were rated the most painful to perform. In addition, patients with chronic thoracic surgery related pain also frequently report pain in other locations, most commonly back pain.

Danish vs American Patients

Ringsted et al (10) reported that 31.7% (27.8% to 35.8%) of their surveyed thoracic surgery patients suffer with chronic postsurgical pain syndrome 12 to 35 months after surgery. The average cumulative pain impairment score was 6.95 ± 9.50 based on 13 items for the Danish patients. In our study, chronic pain was present in 35.9% (95% CI: 26.1% to 46.5%) of the patients 6 to 36 months after surgery and the average cumulative pain impairment score for the same 13 questionnaire items was (8.16 ± 10.54) for American patients who were operated at the University of Iowa Hospitals and Clinics. Incidences of chronic pain (P = 1.0) and the cumulative pain impairment scores (P = 0.175) were not statistically significant between the 2 studies. Even if there are cultural differences between the 2 populations, the procedure-specific questionnaire generated similar results in our sample of American patients.

Ringsted et al's initial questionnaire included 17 items (10) and then removed 4 items that were rarely performed. In our sample, the majority of patients performed these activities; only 42% of the patients rated "never perform" for "running"; less than 40% of the patients for "cycling" and "swimming"; and less than 10% for "driving a car." The driving item did not impair 68.5% of the patients, and it was rated as one of the least painful activities to perform.

The only performance with infit mean square value outside of the -2, +2 range was swimming (infit mean square = 2.2). The swimming question may be a misfit and thus may not be predicted by patients' responses to the other 16 questions.

We have shown the concurrent validity of the English version of Ringsted et al's questionnaire (10) with respect to the severity of the thoracic surgery related pain. We also demonstrated the criterion validity of the questionnaire by demonstrating higher cumulative pain impairment scores among those patients with chronic pain related to thoracic surgery. The evidence for the construct validity was found in the hierarchy of average item difficulty identified by the Rasch analysis; running, cycling, and swimming activities were rated most difficult, while watching TV was rated the least difficult (Fig. 3).

The Incidence of Chronic Pain

Based on meta-analysis of prospective studies, Bayman and Brennan (1) reported the incidence of chronic pain as 57% (95% CI: 51% to 64%) at 3 months and 47% (95% CI: 39% to 56%) at 6 months after thoracotomy. In the current study, both thoracotomy (23%) and thoracoscopy (77%) patients were included 6 months to 3 years after their surgery. It may be unsurprising, therefore, that the reported incidence of chronic pain in the current study (36% [95% CI: 26% to 47%]) is lower compared to the meta-analysis results at 6 months.

Several previous studies report that between 33% and 56% of patients develop chronic pain that interferes with daily activities following thoracic surgery (5-7). Differences in the enrollment period, study population, and type of surgery limit direct comparisons between studies. Our results are valuable as an independent assessment of chronic pain after thoracic surgery, but more so because our study provides a detailed assessment of the effect of chronic pain on daily activities in an American population.

Limitations

Our study had some limitations, most of which are inherent in questionnaire studies. First, of the 349 eligible patients, only 26.4% (n = 92) returned the questionnaires. While many factors were similar, nonresponders were slightly older. It is possible that pain may influence the likelihood to respond. Second, associated with the low response rate, our sample size is small. Third, because of the retrospective nature of the questionnaire, we could not assess or control all the preoperative, intraoperative, and acute factors that may have affected the presence of chronic pain after thoracic surgery. For example, it is not known if headache and back pain are a consequence of thoracic surgery or patients with headache or back pain are more likely to develop chronic pain after thoracic surgery. There is a need for a study prospectively investigating the associations of these potential factors with the development of chronic pain after thoracic surgery and the effect of chronic pain on daily activities.

Conclusions

In conclusion, we showed that even if there are cultural and sociodemographic differences between American and Danish samples, the procedure-specific questionnaire assessed the functional impairment due to thoracic surgery similarly in American patients. Chronic pain is observed in 36% of patients 6 months to 3 years after either thoracotomy or VATS. Pain impairs most aspects of daily life for more than 50% of the patients with chronic postsurgical pain. Pain in other body regions was more common among patients with pain after thoracic surgery.

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