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Effects of Integrative Medicine on Pain and Anxiety Among Oncology Inpatients

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Background Few studies have investigated the effectiveness of integrative medicine (IM) therapies on pain and anxiety among oncology inpatients.

Methods Retrospective data obtained from electronic medical records identified patients with an oncology International Classification of Diseases-9 code who were admitted to a large Midwestern hospital between July 1, 2009 and December 31, 2012. Outcomes were change in patient-reported pain and anxiety, rated before and after individual IM treatment sessions, using a numeric scale (0–10).

Results Of 10 948 hospital admissions over the study period, 1833 (17%) included IM therapy. Older patients had reduced odds of receiving any IM therapy (odds ratio [OR]: 0.97, 95% confidence interval [95% CI] = 0.96 to 0.98) and females had 63% (OR: 1.63, 95% CI = 1.38 to 1.92) higher odds of receiving any IM therapy compared with males. Moderate (OR: 1.97, 95% CI = 1.61 to 2.41), major (OR: 3.54, 95% CI = 2.88 to 4.35), and extreme (OR: 5.96, 95% CI = 4.71 to 7.56) illness severity were significantly associated with higher odds of receiving IM therapy compared with admissions of minor illness severity. After receiving IM therapy, patients averaged a 46.9% (95% CI = 45.1% to 48.6%, P <.001) reduction in pain and a 56.1% (95% CI = 54.3% to 58.0%, P <.001) reduction in anxiety. Bodywork and traditional Chinese Medicine therapies were most effective for reducing pain, while no significant differences among therapies for reducing anxiety were observed.

Conclusions IM services to oncology inpatients resulted in substantial decreases in pain and anxiety. Observational studies using electronic medical records provide unique information about real-world utilization of IM. Future studies are warranted and should explore potential synergy of opioid analgesics and IM therapy for pain control.

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Pain is a common, often debilitating symptom of cancer and a side effect of cancer treatment, affecting more than 50% of cancer patients (1,2). Consequentially, pain management plays a central role in cancer treatment (1). In addition to pain, ~13%–79% of oncology patients suffer from anxiety symptoms (3), although the relationship between pain and anxiety is complex and not yet well understood (4). Undertreatment of cancer-related pain is a major challenge for health-care providers, with nearly one in two patients with cancer pain being undertreated (5). At the same time, however, overuse of opioid analgesics in cancer treatment can lead to opioid tolerance or dependence and side effects such as nausea and constipation (6). Despite ongoing improvements in cancer care (7), pain management is an area with room for improvement.

Complementary and alternative medicine therapies have been used among cancer patients for decades, and the growing use of these therapies across the prevention and treatment spectrum is well documented (8,9). Prevalence of complementary and alternative medicine use among adult cancer patients in the United States has been estimated at 40.5% (10). The establishment of integrative oncology programs at major cancer centers (11) underscores the increasing acceptance of integrative approaches across both outpatient and inpatient populations.

The evidence base for integrative oncology among inpatients is comprised predominantly of small randomized controlled trials conducted over the past three decades, in which pain reduction has been reported (12–20). A larger, 2004 observational study of massage therapy showed reductions in pain and other symptoms, but this study was comprised of both oncology inpatients and outpatients (21). In 2010, Dusek et al. (22) reported a 55.8% average reduction in pain with integrative medicine (IM) use across 1837 inpatients based on a retrospective medical record review, but results for oncology patients were not separately analyzed. In the current study, we evaluate the effectiveness of various integrative medicine therapies for pain and anxiety, focusing specifically on a large, inpatient oncology population. To our knowledge, this study is the first in which multiple IM therapies are studied among oncology inpatients to treat pain and anxiety.

Materials and Methods

Study Design and Setting

This retrospective, observational study of oncology inpatients was conducted at Abbott Northwestern Hospital, a 630-bed teaching

and specialty hospital in Minneapolis, MN. The Penny George Institute for Health and Healing at Abbott Northwestern offers hospitalized patients, through physician and nurse referrals, a wide array of integrative health services for pain relief, anxiety reduction, and healing at no charge (23).

Study Population

All oncology inpatients aged 18 years or older at Abbott Northwestern Hospital, who were admitted between July 1, 2009 and December 31, 2012, were included in the study population. We excluded patients who were seen as outpatients, in the emergency room, and who were in the hospital solely for observation. Electronic medical record (EMR) data were obtained on all eligible inpatients and oncology patients were retrospectively identified using EMR (Epic, Verona, WI). All patients whose data were obtained had provided written permission upon admission to Abbott Northwestern Hospital for their medical records to be used for general research purposes.

The study population included patients with primary malignant neoplasms identified using International Classification of Diseases, 9th Revision, Clinical Modification diagnosis codes (140.0–209.79). Any hospital admission that had at least one of these International Classification of Diseases-9 codes as a primary or secondary diagnosis was eligible for the study.

We created nonmutually exclusive indicators pertaining to primary malignancy site: female breast (174–174.9); bronchus, lung, and trachea (162.0, 162.2–162.5, 162.8–162.9, 209.21); colorectal (153–154, 209.10, 209.17); hematopoietic and lymph (200.0–208.92); and prostate (185). Patients of all other primary malignancies were grouped into an "other" cancer site category. Inpatients with benign neoplasms (210–229), carcinomas in situ (230–234), and neoplasms of uncertain behavior (235–238) or unspecified nature (239) were excluded.

The study was approved by the Institutional Review Board of Allina Health with a waiver of informed consent.

Measurements

Demographic and Hospital Admission Characteristics. Data extracted from the EMR included patients' ages at time of hospital admission, sex, race, marital status, and health insurance status. Our data included the All Patient Refined Diagnostic Related Groups (24) severity of illness measures calculated from patients' diagnoses codes. The measure includes four categories of severity: 1) minor, 2) moderate, 3) major, and 4) extreme. Data pertaining to each IM session were routinely documented within the EMR.

IM Therapies. IM practitioners used their clinical judgment to provide therapies, within their scope of practice, they deemed necessary and therapeutic for each patient, after consulting with the patient. Many patients received IM therapy multiple times throughout a hospital admission. We use the term "session" to define each unique administration of IM therapy, distinguished by time of procedure, within a hospital admission. For the present analysis, IM therapies were placed into one of three broad categories: bodywork, which included craniosacral therapy, medical massage, and reflexology; mind-body and energy therapies (MBE), which was divided into separate mind-body and energy subcategories; and traditional Chinese medicine, which included acupressure, acupuncture, and Korean hand therapy. Also, patients could receive therapy from more than one category during each session, which we define as combination therapies. We coded the presence or absence of each of these IM therapies at each session such that bodywork, MBE, traditional Chinese medicine, and any combination of these therapies were mutually exclusive.

Pain and Anxiety Scores. For patients who received IM services, practitioners collected patients' self-reported pain and anxiety scores directly before and after each IM session. Practitioners use standard procedures to request patients to indicate the level of pain they were currently experiencing on an 11-point numeric rating scale where 0 was defined as "no pain" and 10 was defined as "worst pain imaginable." Similarly, practitioners recorded anxiety scores using the same methodology, where 0 was "no anxiety" and 10 was "worst anxiety imaginable." The primary endpoints were change in pain and anxiety scores, calculated by subtracting the prescore from the postscore.

Analytic Dataset

We identified 11 078 oncology-related hospital admissions in the EMR. We removed 20 hospital admissions due to missing demographic data (six admissions) or inability to determine severity of illness (14 admissions). Additionally, we excluded 110 hospital admissions because we were unable to classify their health insurance status as commercial, Medicare, or Medicaid (only nine of these 110 admissions received IM therapy), resulting in 10 948 oncology admissions from 7727 unique patients. Of the 10 948 admissions, 1833 (17%) had 4517 IM therapy sessions (an average of 2.46 per admission). In many cases, practitioners were unable to collect pre- or post-pain and anxiety scores or the patient reported no pain or anxiety. Only patients who reported both pre- and post-pain or pre- and post-anxiety scores were included in the subsequent analyses.

Because we observed IM therapy at the hospital admission level, but pain and anxiety scores were assessed at the IM session level, we randomly selected one session from each remaining hospital admission to keep the level of analysis consistent between the selection and score change equations (see below). Thus, we dropped all hospital admissions with only missing scores or only pre-pain or -anxiety scores equal to zero. This method produced a sample of 9998 hospital admissions for the pain model, of which 883 (9%) had IM therapy, and 9771 admissions for the anxiety model, of which 656 (7%) had IM therapy.

Statistical Analysis

IM Therapy Utilization. Logistic regression was used to predict the probability of receiving any IM therapy during a hospital admission as a function of patient demographics, cancer site, severity, and health insurance status, and we present the odds ratios (ORs) for each covariate. A P value of less than .05 was used to signify statistically significant differences. To correct for serial correlation among patients with multiple hospital admissions, we clustered standard errors by patient. The goodness-of-fit of our model was tested using a Hosmer–Lemeshow test (25) as well as calculating the percent of admissions correctly classified by the model.

Pain and Anxiety. To determine if IM therapies were associated with reductions in pain and anxiety, we first conducted paired t tests

using the null hypothesis that the pre- and post-pain or anxiety scores were equal.

Second, multivariate regression was used to estimate reductions in pain and anxiety during IM sessions. Because patients receiving IM therapy may systematically differ from the general sample of oncology patients, an ordinary least squares model could produce bias parameters when generalizing results. To address this bias, we used a Heckman selection model (26) to account for selection into the sample of IM therapy recipients.

To correctly identify the parameters that affect pain and anxiety, at least one variable in the selection-equation (ie, utilization of IM therapy) should be specified which predicts IM therapy use, but does not affect changes in pain or anxiety. We expected marital status and health insurance status to fit this criterion. Therefore, our model predicted selection into the sample of IM sessions using all patient demographic, cancer site, severity variables (the same set of covariates as our logistic regression predicting IM therapy use). Changes in pain and anxiety scores were estimated using cancer site, age, sex, race, severity, and the inverse Mills ratio calculated from the selection-equation to control for selection. Additionally, we estimated a second model, which included IM therapy categories, to determine if differential effects between the categories existed. As above, to correct for serial correlation among patients with multiple observations, we clustered standard errors by patient.

We conducted all analyses in Stata Version 13 (StataCorp LP, College Station, TX).

Results

Descriptive Statistics

Of the 10948 hospital admissions over the study period, 1833 (17%) included IM therapy (Table 1). The mean age of inpatients utilizing IM therapies (59.0 years) was nearly 6 years younger than inpatients not utilizing IM therapies (64.9 years). Women accounted for the majority of both IM and non-IM hospital admissions; however, admissions with IM services had a higher proportion of female patients, 64%, than non-IM admissions, 56%. The distributions of cancer sites were similar across IM and non-IM hospital admissions, although IM hospital admissions were comprised of patients with statistically significant higher illness severity. A total of 4517 IM therapy sessions were administered for an average of 2.46 sessions per hospital admission (Table 2). Bodywork comprised 54.8% compared with 13.0% for MBE, 9.7% for traditional Chinese medicine, and 22.6% for combination therapies.

IM Therapy Utilization Analysis

Similar to our descriptive statistics, older patients had reduced odds of receiving any IM therapy in our logistic regression model (Table 3). Females had 63% (OR: 1.63, 95% confidence interval [CI] = 1.38 to 1.92, P <.001) higher odds of receiving any IM therapy during a hospital admission compared with males. We found that moderate (OR: 1.97, 95% CI = 1.61 to 2.41, P <.001), major (OR: 3.54, 95%

Table 1. Abbott Northwestern oncology inpatient characteristics (n = 10948)*

	No IM therapy (n = 9115)	IM therapy (n = 1833)	*P*
Age (y ± SD)	64.9 ± 14.6	59.0 ± 14.2	<.001
Sex (column %; row %)			
Female	5101 (56.0; 81.3)	1117 (64.2; 18.7)	<.001
Male	4014 (44.0; 86.0)	656 (35.8; 14.0)	<.001
Race (column %; row %)			
White	8385 (92.0; 83.3)	1680 (91.7; 16.7)	.628
African American	487 (5.3; 82.0)	107 (5.8; 18.0)	.394
Asian	83 (0.9; 83.0)	17 (0.9; 17.0)	.945
Other	160 (1.8; 84.7)	29 (1.6; 15.3)	.603
Marital status (column %; row %)			
Married	5324 (58.4; 82.5)	1127 (61.5; 17.5)	.015
Widow	1430 (15.7; 88.3)	189 (10.3; 11.7)	<.001
Divorced	827 (9.1; 82.7)	173 (9.4; 17.3)	.621
Single	1534 (16.8; 81.7)	344 (18.8; 18.3)	.045
Cancer site (column %; row %)			
Breast	1526 (16.7; 84.5)	279 (15.2; 15.5)	.109
Colorectal	842 (9.2; 86.8)	128 (7.0; 13.2)	.002
Lung, bronchus, and trachea	768 (8.4; 83.2)	155 (8.5; 16.8)	.966
Lymph and hematopoietic	1012 (11.1; 78.7)	274 (14.9; 21.3)	<.001
Prostate	765 (8.4; 93.1)	57 (3.1; 6.9)	<.001
Other	4447 (48.8; 82.0)	978 (53.4; 18.0)	<.001
Severity of illness (column %; row %)			
Minor	1637 (18.0; 91.5)	153 (8.3; 8.5)	<.001
Moderate	3527 (38.7; 85.3)	606 (33.1; 14.7)	<.001
Major	3022 (33.2; 80.9)	715 (39.0; 19.1)	<.001
Extreme	929 (10.2; 72.1)	359 (19.6; 27.9)	<.001
Health insurance (column %; row %)			
Commercial	3891 (42.7; 79.5)	1001 (54.6; 20.5)	<.001
Medicare	3996 (43.8; 86.8)	610 (33.3; 13.2)	<.001
Medicaid	1228 (13.5; 84.7)	222 (12.1; 15.3)	.117

* *P* calculated from two-tailed *t* test comparing no integrative medicine (IM) therapy and IM therapy, adjusted for equal or unequal variances as appropriate.

Table 2. Distribution of integrative medicine (IM) sessions by treatment type and cancer site*

	Cancer site						
	Any site	**Breast**	**Colorectal**	**Lung, bronchus, and trachea**	**Lymph and hematopoietic**	**Prostate**	**Other**
Number of oncology admissions with IM therapy	1833	279	128	155	274	57	978
Number of total IM sessions (%)	4517 (100.0)	554 (100.0)	404 (100.0)	368 (100.0)	849 (100.0)	163 (100.0)	2326 (100.0)
BW (%)	2474 (54.8)	244 (44.0)	207 (51.2)	203 (55.2)	450 (53.0)	98 (60.1)	1352 (58.1)
Craniosacral	2 (<0.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1 (<0.1)
Medical massage	1782 (39.5)	174 (31.4)	150 (37.1)	178 (48.4)	282 (33.2)	87 (53.4)	964 (41.4)
Reflexology	666 (14.7)	65 (11.7)	56 (13.9)	25 (6.8)	163 (19.2)	11 (6.7)	373 (16.0)
Multiple BW treatments	24 (0.5)	5 (0.9)	1 (0.2)	0 (0.0)	4 (0.5)	0 (0.0)	14 (0.6)
MBE (%)	587 (13.0)	85 (15.3)	56 (13.9)	44 (12.0)	174 (20.5)	7 (4.3)	242 (10.4)
Mind-body	255 (5.6)	31 (5.6)	24 (5.9)	23 (6.3)	65 (7.7)	5 (3.1)	111 (4.8)
Energy	267 (5.9)	47 (8.5)	21 (5.2)	16 (4.3)	89 (10.5)	2 (1.2)	103 (4.4)
Multiple MBE treatments	65 (1.4)	7 (1.3)	11 (2.7)	5 (1.4)	20 (2.4)	0 (0.0)	28 (1.2)
TCM (%)	437 (9.7)	53 (9.6)	44 (10.9)	27 (7.3)	53 (6.2)	35 (21.5)	232 (10.0)
Acupressure	104 (2.3)	13 (2.3)	10 (2.5)	9 (2.4)	10 (1.2)	9 (5.5)	56 (2.4)
Acupuncture	217 (4.8)	25 (4.5)	27 (6.7)	17 (4.6)	26 (3.1)	14 (8.6)	110 (4.7)
Korean hand therapy	54 (1.2)	8 (1.4)	5 (1.2)	1 (0.3)	10 (1.2)	6 (3.7)	24 (1.0)
Multiple TCM treatments	62 (1.4)	7 (1.3)	2 (0.5)	0 (0.0)	7 (0.8)	6 (3.7)	42 (1.8)
Combination therapy (%)	1019 (22.6)	172 (31.0)	97 (24.0)	94 (25.5)	172 (20.3)	23 (14.1)	500 (21.5)
BW-MBE	671 (14.9)	111 (20.0)	66 (16.3)	73 (19.8)	120 (14.1)	12 (7.4)	318 (13.7)
BW-TCM	118 (2.6)	16 (2.9)	11 (2.7)	8 (2.2)	21 (2.5)	4 (2.5)	62 (2.7)
MBE-TCM	168 (3.7)	26 (4.7)	16 (4.0)	6 (1.6)	25 (2.9)	7 (4.3)	94 (4.0)
BW-MBE-TCM	62 (1.4)	19 (3.4)	4 (1.0)	7 (1.9)	6 (0.7)	0 (0.0)	26 (1.1)

* IM sessions for patients with more than one cancer during a hospital admission count under the "Any site" column as well as under the appropriate cancer site columns. As such, the sum of individual cancer site columns does not equal the sum of the "Any site" column. BW = bodywork; MBE = mind-body and energy therapy; TCM = traditional Chinese medicine.

Table 3. Odds ratio (OR) for integrative medicine (IM) use among oncology inpatients*

	OR	**95% CI**	***P***
Age, y	0.97	(0.96 to 0.98)	<.001
Sex (reference = male)			
Female	1.63	(1.38 to 1.92)	<.001
Race (reference = white)			
African American	0.95	(0.68 to 1.33)	.768
Asian	0.88	(0.45 to 1.71)	.701
Other/unknown	0.71	(0.45 to 1.14)	.159
Marital status (reference = married)			
Widowed	0.80	(0.65 to 0.98)	.032
Divorced/separated	0.94	(0.75 to 1.16)	.546
Single	0.81	(0.68 to 0.97)	.025
Cancer site (reference = other)			
Breast	0.80	(0.67 to 0.96)	.014
Colorectal	0.79	(0.62 to 1.01)	.057
Lung, bronchus, and trachea	0.99	(0.80 to 1.23)	.942
Lymph and hematopoietic	1.27	(1.03 to 1.56)	.026
Prostate	0.68	(0.49 to 0.93)	.015
Severity of illness (reference = minor)			
Moderate	1.97	(1.61 to 2.41)	<.001
Major	3.54	(2.88 to 4.35)	<.001
Extreme	5.96	(4.71 to 7.56)	<.001
Health insurance (reference = commercial)			
Medicare	0.82	(0.69 to 0.98)	.032
Medicaid	0.73	(0.59 to 0.88)	.001

* ORs from logistic regression of 10948 oncology hospital admissions. The dependent variable was administration of IM therapy during hospital admission. CI = confidence interval.

CI = 2.88 to 4.35, P <.001), and extreme (OR: 5.96, 95% CI = 4.71 to 7.56, P <.001) illness severity were all significantly associated with higher odds of receiving IM therapy compared with patients with hospital admissions of minor illness severity.

The P value from a Hosmer–Lemeshow test was .54, indicating a good fit. The model correctly classified 83% of hospital admissions as receiving IM or not receiving IM. Although this result was driven by the model's under-prediction of IM

Table 4. Pre- to postintegrative medicine (IM) therapy percent decrease in pain and anxiety scores by cancer site and therapy type*

		Cancer site						
		Any cancer site	**Breast**	**Colorectal**	**Lung, bronchus, and trachea**	**Lymph and hematopoietic**	**Prostate**	**Other**
Any treatment	Number of pain observations	1514	184	166	123	232	57	798
	% Decrease in pain	46.9	49.6	47.8	51.1	48.7	32.1	45.4
	95% CI	(45.1 to 48.6)	(44.9 to 54.2)	(43.0 to 52.7)	(44.9 to 57.3)	(43.9 to 53.4)	(24.5 to 39.7)	(42.9 to 47.9)
	P	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	Number of anxiety observations	1074	107	114	105	219	21	552
	% Decrease in anxiety	56.1	58.9	50.6	60.3	58.6	64.3	54.3
	95% CI	(54.3 to 58.0)	(53.1 to 64.7)	(45.2 to 55.9)	(54.3 to 66.2)	(54.1 to 63.2)	(51.0 to 77.5)	(51.9 to 56.8)
	P	<.001	<.001	<.001	<.001	<.001	<.001	<.001
BW	Number of pain observations	901	90	94	66	142	40	503
	% Decrease in pain	48.5	49.6	47.9	50.8	50.9	32.9	47.8
	95% CI	(46.5 to 50.6)	(43.1 to 56.0)	(41.5 to 54.4)	(42.7 to 58.9)	(45.7 to 56.2)	(24.5 to 41.3)	(45.0 to 50.5)
	P	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	Number of anxiety observations	630	46	67	53	141	12	339
	% Decrease in anxiety	55.8	58.6	47.7	56.0	57.6	44.0	56.5
	95% CI	(53.5 to 58.2)	(50.0 to 67.3)	(40.5 to 55.0)	(47.6 to 64.5)	(52.7 to 62.4)	(30.6 to 57.3)	(53.3 to 59.6)
	P	<.001	<.001	<.001	<.001	<.001	<.001	<.001
MBE	Number of pain observations	100	18	10	11	16	—	49
	% Decrease in pain	41.3	41.2	56.6	41.7	50.0	—	36.1
	95% CI	(34.4 to 48.2)	(25.5 to 56.9)	(31.6 to 81.7)	(16.8 to 66.5)	(32.0 to 68.0)	—	(26.9 to 45.3)
	P	<.001	<.001	.002	.008	<.001	—	<.001
	Number of anxiety observations	94	15	9	12	23	—	40
	% Decrease in anxiety	56.1	47.9	59.9	64.1	59.3	—	51.9
	95% CI	(50.3 to 61.9)	(34.7 to 61.1)	(40.9 to 78.9)	(49.0 to 79.1)	(47.2 to 71.4)	—	(42.9 to 60.9)
	P	<.001	<.001	<.001	<.001	<.001	—	<.001
TCM	Number of pain observations	115	20	17	—	15	10	54
	% Decrease in pain	45.7	56.2	54.1	—	52.0	31.2	40.4
	95% CI	(35.6 to 55.8)	(40.2 to 72.2)	(35.2 to 73.0)	—	(34.4 to 69.5)	(8.3 to 54.2)	(21.7 to 59.2)
	P	<.001	<.001	<.001	—	<.001	.026	<.001
	Number of anxiety observations	44	6	3	—	6	7	23
	% Decrease in anxiety	61.6	42.2	66.7	—	35.9	91.7	60.9
	95% CI	(46.3 to 76.9)	(11.0 to 73.4)	(1.3 to 132.0)	—	(−57.5 to 129.3)	(81.0 to 102.4)	(47.8 to 74.0)
	P	<.001	.045	.184	—	.485	<.001	<.001
Combination	Number of pain observations	398	56	45	46	59	6	192
	% Decrease in pain	44.8	49.8	43.3	53.7	42.1	33.9	42.9
	95% CI	(41.3 to 48.3)	(41.5 to 58.2)	(35.5 to 51.2)	(43.4 to 64.0)	(30.1 to 54.0)	(6.4 to 61.4)	(38.0 to 47.8)
	P	<.001	<.001	<.001	<.001	<.001	.061	<.001
	Number of anxiety observations	306	40	35	40	49	2	150
	% Decrease in anxiety	55.9	65.9	52.2	64.8	64.2	90.0	49.2
	95% CI	(52.7 to 59.2)	(56.4 to 75.4)	(44.2 to 60.2)	(54.9 to 74.6)	(56.1 to 72.3)	(70.4 to 109.6)	(44.8 to 53.6)
	P	<.001	<.001	<.001	<.001	<.001	.070	<.001

* BW = bodywork; CI = confidence interval; MBE = mind-body and energy therapies; TCM = traditional Chinese medicine.

hospital admissions and the large proportion of non-IM hospital admissions, we found a significant difference (P <.001) in the predicted probability of receiving IM therapy between IM hospitals admissions (P = .23) and non-IM hospital admissions (P = .16).

Pain and Anxiety Analysis

Sessions with IM therapy had, on average, a 46.9% (95% CI = 45.1 to 48.6%, P value <.001) decrease in pain score (Table 4). Anxiety scores decreased by an average of 56.1% (95% CI = 54.3% to 58.0%, P <.001) after the administration of IM therapies (Table 4).

For a male with mean age (63.9), mean inverse Mills ratio (1.91), and the modal value of all categorical variables (ie, white, "other" cancer, and moderate severity), our model predicts that IM therapy is associated with a 2.00 (95% CI = 1.71 to 2.30, P <.001) point reduction in pain (base model; Table 5). This result represents a 42.9% (95% CI = 36.7% to 29.4%, P <.001) decrease in pain for a male with the mean pain prescore (4.66). For a female

Table 5. Predicted change in pain and anxiety scores*

	Base model		Model including treatment type	
Outcome	**Marginal effect**	***P***	**Marginal effect**	***P***
Pain				
Age, y	<0.01	.729	<0.01	.603
Female	0.14	.346	0.07	.626
Race (reference = white)				
African American	−0.26	.324	−0.25	.339
Asian	0.32	.430	0.34	.380
Other	0.54	.036	0.53	.035
Cancer site (reference = other)				
Breast	−0.18	.329	−0.21	.230
Colorectal	−0.26	.182	−0.29	.140
Lung, bronchus, and trachea	−0.49	.062	−0.58	.024
Lymph and hematopoietic	−0.04	.821	−0.04	.806
Prostate	0.59	.035	0.56	.046
Severity of illness (reference = minor)				
Moderate	−0.38	.126	−0.34	.158
Major	−0.36	.230	−0.31	.266
Extreme	−0.33	.357	−0.25	.437
Treatment type (reference = BW)				
MBE	—	—	0.85	<.001
TCM	—	—	0.18	.528
Combination	—	—	0.32	.012
Inverse Mills ratio	0.02	.941	0.08	.733
Constant	−1.51	.006	−1.72	.000
Anxiety				
Age, y	0.08	<.001	0.08	<.001
Female	−1.44	<.001	−1.41	<.001
Race (reference = white)				
African American	0.98	.027	0.97	.028
Asian	−0.50	.680	−0.51	.671
Other	0.58	.347	0.63	.311
Cancer site (reference = other)				
Breast	1.10	<.001	1.10	.000
Colorectal	−0.27	.431	−0.26	.434
Lung, bronchus, and trachea	−0.92	.007	−0.89	.009
Lymph and hematopoietic	−0.51	.088	−0.51	.091
Prostate	1.37	.026	1.23	.050
Severity of illness (reference = minor)				
Moderate	−1.10	.002	−1.10	.002
Major	−2.12	<.001	−2.10	<.001
Extreme	−3.10	<.001	−3.09	<.001
Treatment type (reference = BW)				
MBE	—	—	−0.14	.460
TCM	—	—	0.45	.199
Combination	—	—	−0.13	.354
Inverse Mills ratio	−3.61	<.001	−3.60	<.001
Constant	1.82	.006	1.82	.007

* Marginal effect of covariates on the change in pain and anxiety scores after administration of integrative medicine (IM) therapy from a Heckman selection model. Marital status and health insurance were used as exclusion restrictions in the selection-equation. Hospital admissions for which all change in pain or anxiety score were missing were excluded from this analysis. The pain sample consisted of 9998 admissions, of whom 883 used IM therapies; the anxiety sample consisted of 9771 admissions, of whom 656 used IM therapies. BW = bodywork; MBE = mind-body and energy therapies; TCM = traditional Chinese medicine.

with the same admission attributes, IM therapy was associated with a 39.9% (95% CI = 34.3%–45.5%, P <.001) reduction in pain.

When IM therapy categories were included in the regression analysis, we found bodywork therapy was 18.2 percentage points (95% CI = 11.4% to 25.3%, P <.001) more effective than MBE therapy and 6.9 percentage points (95% CI = 1.5% to 25.3%, P = .012) more effective than combination therapy at the mean pre-pain score. Additionally, we found traditional Chinese medicine was 14.3 percentage points (95% CI = 1.0% to 27.6%, P = .033) and combination therapy was 11.3 percentage points (95% CI = 3.8% to 18.9%, P = .003) more effective than MBE. The inverse Mills ratio had an insignificant effect on pain, suggesting that selection bias was not present.

We predicted a 1.63 (95% CI = 0.92 to 2.33, P <.001) point decrease (Table 5) or a 30.1% (95% CI = 17.3% to 43.7%, P <.001) reduction in anxiety score for a male with mean age (63.9), mean inverse Mills ratio (2.08), and the modal value of all categorical variables with the mean anxiety prescore (5.33). For females, IM therapy was associated with a 57.4% (95% CI = 48.8% to 66.0%, P <.001) reduction in anxiety. We found no significant difference by IM therapy type. The coefficient of the inverse Mills ratio was significant and suggests that a patient who selected into IM therapy received, on average, a greater reduction in anxiety from IM therapy than the expected anxiety reduction for a patient drawn at random from the full population of oncology patients.

Discussion

This retrospective study using standardly collected EMR data is one of the first to comprehensively assess the effects of IM therapies on pain and anxiety among oncology inpatients. Older patients had reduced odds of receiving any IM therapy and females had higher odds of receiving any IM therapy compared with males. Moderate, major, and extreme illness severity were all significantly associated with higher odds of receiving IM therapy compared with hospital admissions of minor illness severity. Overall, IM sessions resulted in an average 46.9% reduction in pain and an average 56.1% reduction in anxiety.

Few observational effectiveness studies of IM for cancer inpatients have been reported, yet real-world data is important for better understanding the effectiveness of integrative therapies for cancer inpatients (27,28). Our results are generally consistent with previous studies involving oncology inpatients, including significantly reduced pain (12–21) and anxiety (19,29); however, the observational design of this study distinguishes it from previous studies [excepting Cassileth and Vickers (21)]. Cancer populations are diverse in many ways, including comorbidities and complex treatment regimens (28). Comparative effectiveness research is appropriate for integrative oncology due to the inclusiveness, wide-ranging outcomes, and decision-making potential of this research approach (28). Furthermore, effectiveness research has been emphasized as beneficial for conducting economic evaluations of complementary and alternative medicine (30). Pain management is a costly part of oncology care; cost analysis of IM, particularly for inpatients, is an area in need of more targeted research.

An important strength of this study over prior investigations is its focus on a large inpatient oncology population. Inpatient complementary and alternative medicine research in oncology populations has mostly involved small sample sizes (12–20,29), with the exception of Cassileth and Vickers' analysis of 961 cancer inpatients receiving massage therapy (21). An additional strength of this study is our use of a Heckman selection model to adjust for any nonrandom selection of whether patients received IM therapy. As a result of this adjustment, our results are generalizable to oncology patients at Abbott Northwestern Hospital. However, these results may not necessarily generalize to other hospital settings. Finally, the large amount of data extracted from EMRs allowed us to perform a comprehensive analysis including multiple cancer sites, IM therapies, and outcome measures. To date, previous investigations had been far more limited in scope.

Some limitations are present in this study. First, we did not investigate the effect opioid analgesics may have had on self-reported pain and anxiety scores. It is possible that our findings overestimate the beneficial effects of IM on pain and anxiety. Future research should include patient use of opioid analgesics and account for time of use in relation to integrative therapies. Second, the EMR data extract from which this analysis was performed did not include specific information on cancer or cancer treatment, which may directly affect pain and anxiety levels. Analyses which account for parameters such as cancer stage, presence of metastases, and treatment type(s) should be considered. Third, our results reflect short-term changes in pain and anxiety; a fuller understanding on the long-term effects of IM on pain and anxiety awaits further research. Finally, since these are self-reported pain and anxiety scores collected by IM practitioners, the potential exists for bias in these scores.

In conclusion, this study provided a unique opportunity to describe and investigate the effectiveness of delivering IM therapy to oncology inpatients. Our results provide evidence that IM therapies substantially reduce both short-term pain and anxiety among oncology inpatients. Observational studies using EMR provide unique information about real-world utilization of IM. Additional investigations into the cost effectiveness of IM therapy for oncology inpatients must be considered.

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