Investigating the Efficacy of a Lovingkindness Meditation Intervention for Patients Undergoing Breast Cancer Surgery: A Randomized Controlled Pilot Study

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Background

- Surgery is a critical component of breast cancer treatment
  - Common treatment-related symptoms:
    - **Emotional distress (e.g., anxiety, depression)**
    - **Physical symptoms (e.g., pain, nausea, fatigue, sleep disturbance)**
  - Limited research investigating psychosocial interventions during surgical time frame

Need for a brief, peri-surgical psychosocial intervention for breast cancer patients

- Positive psychosocial resources have predicted positive adjustment during peri-surgical time frame

Lovingkindness Meditation: A New Direction for Psychosocial Peri-Surgical Protocols

- Lovingkindness meditation (LKM) is an ancient Buddhist practice
  - Developing positive emotions (e.g., love, compassion) towards oneself and others & releasing negative emotions
  - Silent repetition of phrases
    - May I be safe; May I be happy; May I be healthy; May I live with ease

- Brief psychosocial intervention that has the potential lead to psychological and physical well-being in the peri-surgical time frame
  - Decrease in emotional distress, physical symptoms
  - Increase in positive adjustment

Study AIMS & Hypotheses:

Primary Aims:

- Assess the efficacy of a lovingkindness meditation (LKM) protocol on mood and anxiety during biopsy and the peri-surgical period of breast cancer compared to an active control (music) and standard of care
  - Decrease anxiety
  - Improve mood
- Assess the efficacy of a lovingkindness meditation (LKM) protocol on negative physical symptoms during biopsy and the peri-surgical period of breast cancer compared to an active control (music) and standard of care
  - Improve physical outcomes (i.e., pain, fatigue, sleep disturbance, blood pressure, heart rate)

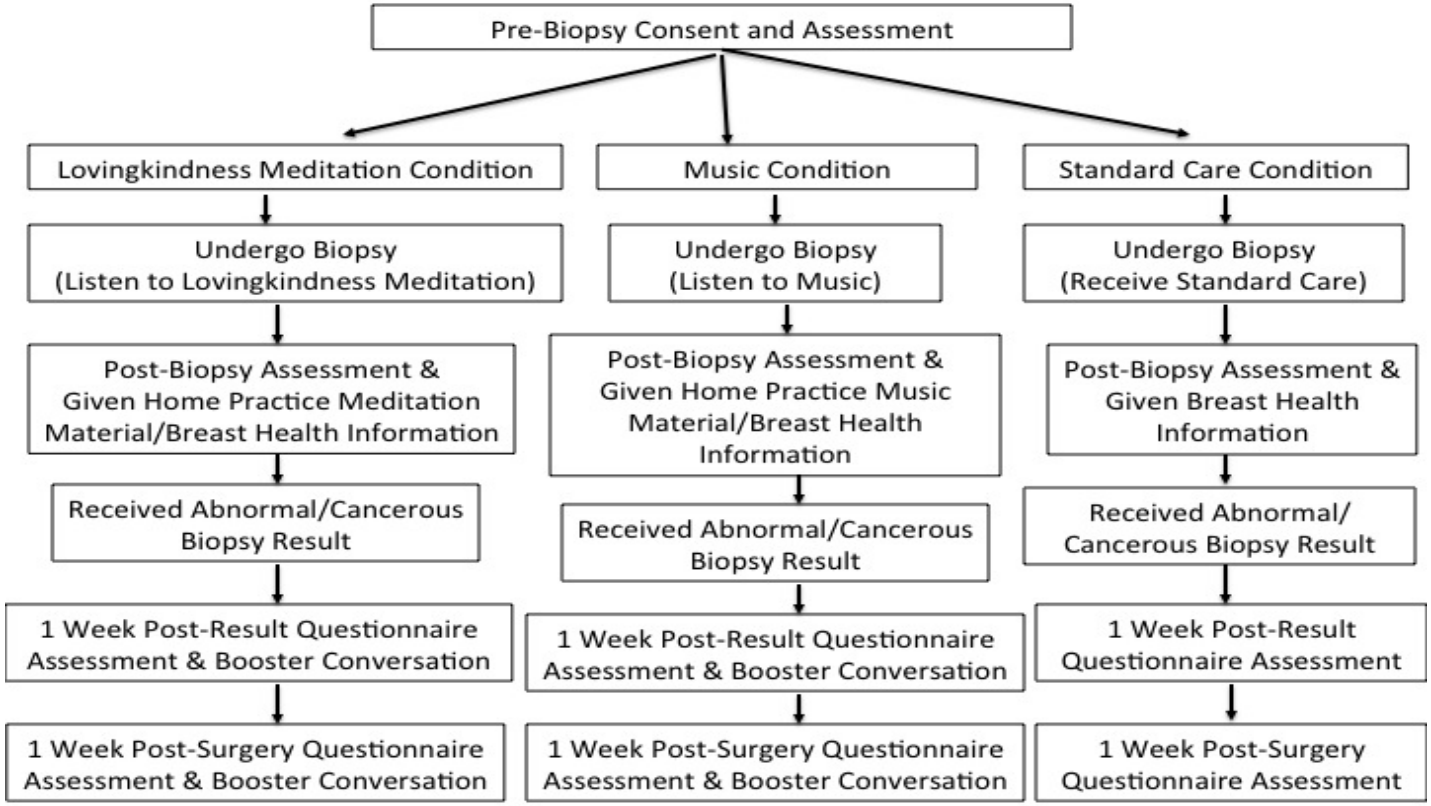
Exploratory Aim:

- Assess whether there is evidence for the Broaden-and-Build hypotheses (i.e., building personal resources)
  - Higher levels of psychological, cognitive, and social resources

Participant Characteristics (N=56)

	M ± SD	N (%)
Age	56 ± 11.26	
Education		
High School		3 (6.2%)
Some College		11 (22.9%)
College		16 (33.3%)
Some Graduate School		5 (10.4%)
Graduate Degree		13 (27.1%)
Race		
Caucasian		39 (73.6%)
African American		12 (22.6%)
Asian American		2 (3.8%)
Married/Partner		32 (62.7%)
Comorbid Condition (e.g., pain, CAD)		38 (68.7%)
History of Anxiety/Depression		9 (17.9%)
Diagnosed with cancer before biopsy		11 (19.6%)
Surgery		
Lumpectomies		36 (64.3%)
Mastectomies		20 (35.7%)

Study Design



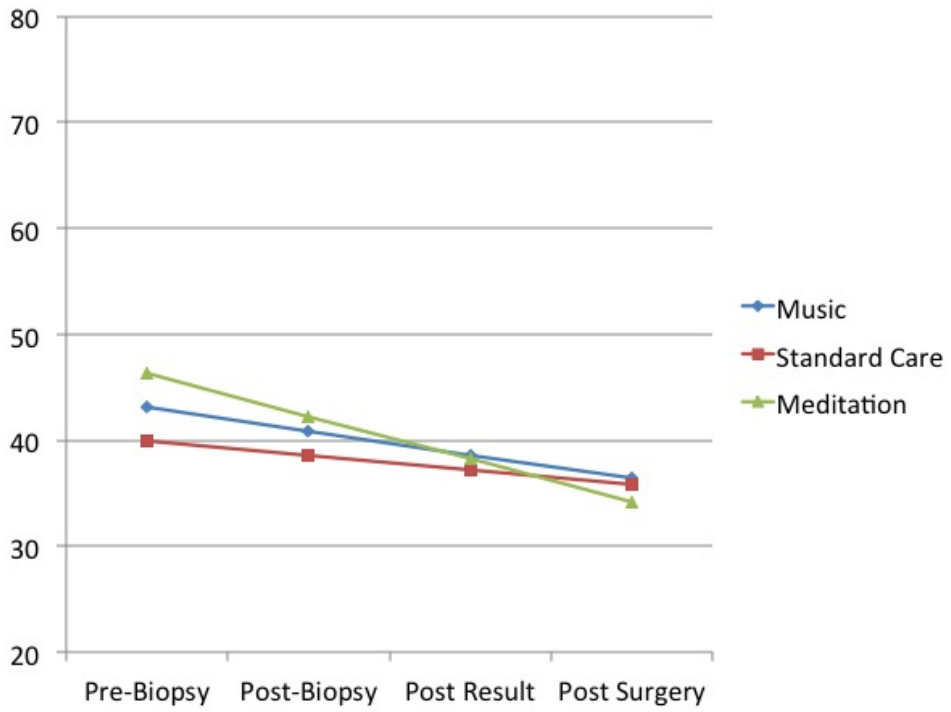
Study Measures

Variables	Measure	α	Response Scale
Anxiety	State Anxiety Scale of STAI (20-item)	.94	1 to 4
Mood	Cohen's Affect Scale (12-item)	PA (.92) NA (.85)	1 to 4
Body Pain	Brief Pain Inventory Scale (4-item)	.88	0 to 10
Breast Pain	Adapted BPI (2-item)	.89	0 to 10
Fatigue	FACIT Fatigue (13-item)	.91	0 to 4
Sleep Disturbance	PROMIS SD (6-item)	.90	1 to 5
Self-Compassion	Self-Compassion Scale (12-item)	.88	1 to 5
Coping	Brief-Cope (28-item)	AC (.88) MC (.78)	1 to 4
Emotion Regulation	Emotion Regulation Questionnaire (10-item)	R (.89) S (.73)	1 to 7
Mindfulness	Five Facet Mindfulness Questionnaire (23-item)	.83-.93	1 to 5
Social Support	PROMIS Emotional Support & PROMIS Social Isolation	ES (.98) SI (.96)	1 to 5
Blood Pressure & Pulse	Automatic inflation blood pressure monitor (upper extremity)		

Results: Primary Outcomes

Anxiety

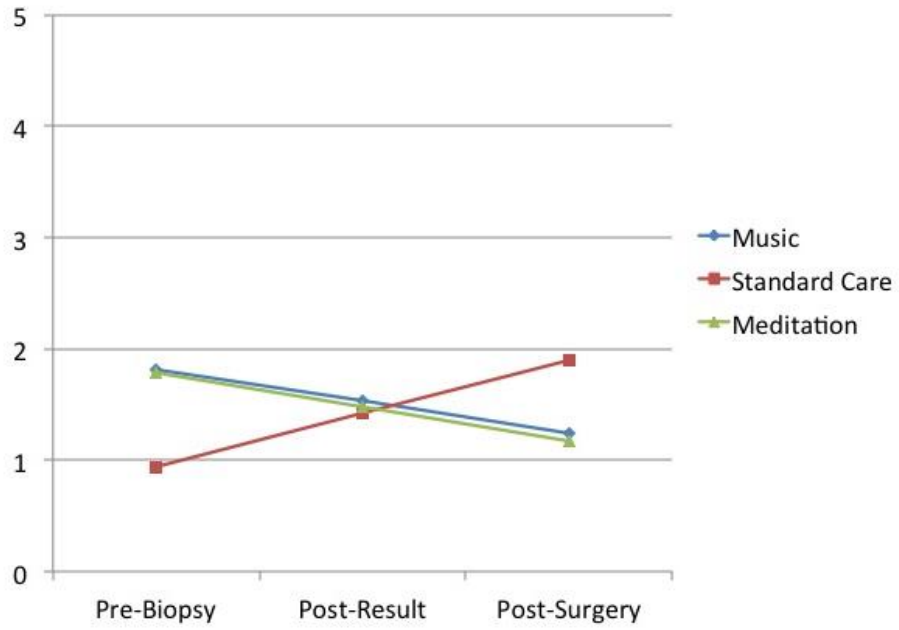
Significant treatment x time interaction (*B*=2.69, *SE*=1.33, *t*=2.02, *p*=0.05)



Results: Primary Outcomes

Body Pain

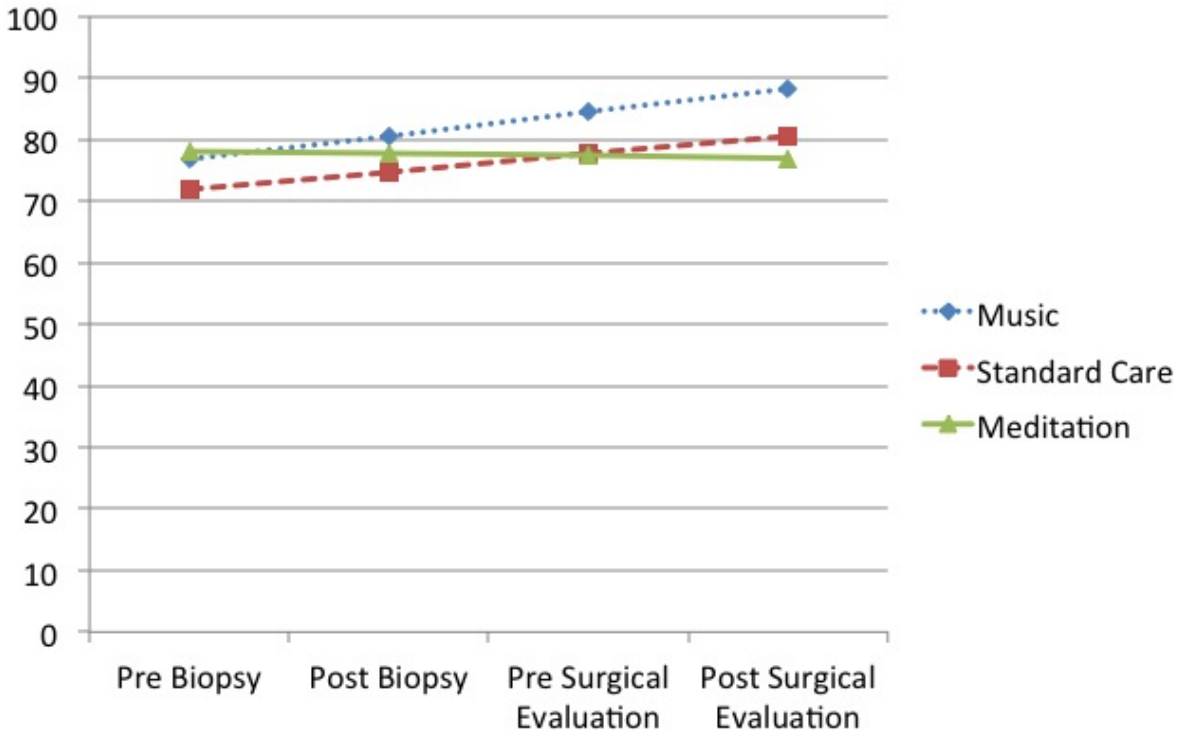
Significant treatment x time interaction (*B*=0.45, *SE*=0.21, *t*=2.10, *p*=0.04)



Results: Primary Outcomes

Heart Rate

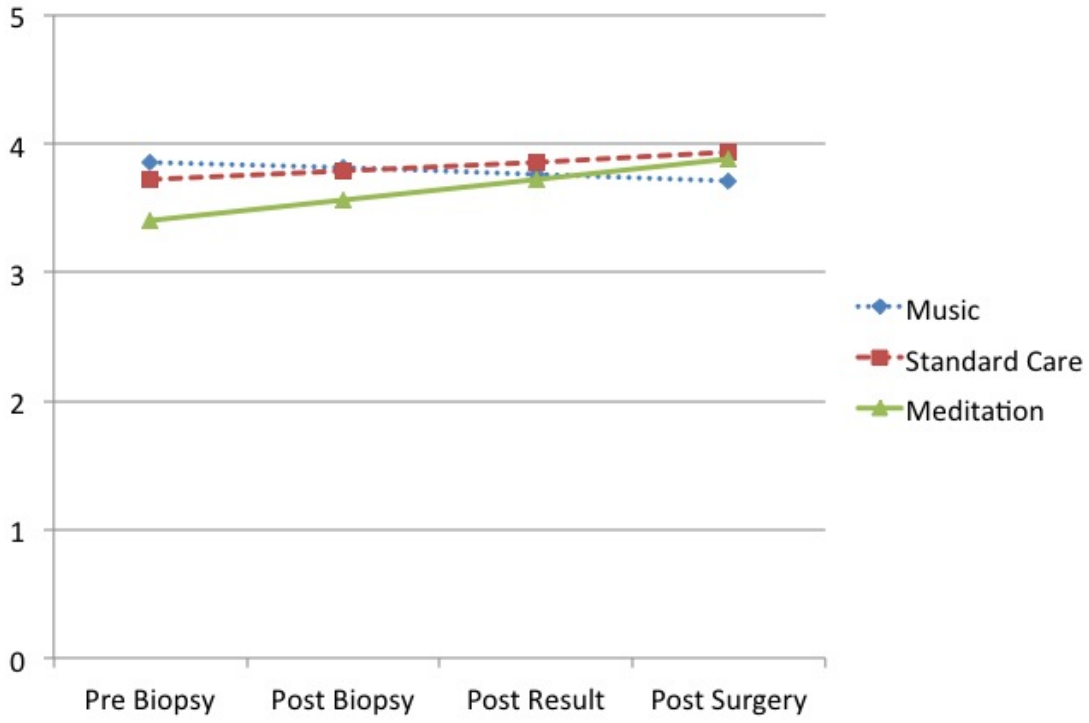
Significant treatment x time interactions: (*B*=4.24, *SE*=1.70, *t*=2.50, *p*=0.02) & (*B*=3.31, *SE*=1.61, *t*=2.05, *p*=0.05)



Results: Exploratory Outcomes

Self-Compassion

Significant treatment x time interaction (*B*=-0.22, *SE*=0.07, *t*=-3.00, *p*=0.004)



Summary of Key Findings

- Patients randomly assigned to the lovingkindness meditation condition showed:
  - Improvements in anxiety over time compared to the standard care (SC) condition
    - **There was a significant reduction in anxiety over time among those who practiced LKM**
  - Improvements in self-compassion and mindfulness over time compared to the music condition
  - Maintenance of baseline levels of body pain over time relative to the SC condition
  - Maintenance of baseline levels of emotional suppression and social isolation over time relative to the music condition
    - **There was a significant reduction in emotional suppression over time among those who practiced LKM**
  - Maintenance of baseline levels of heart rate over time relative to the music and SC conditions
    - **There was a significant reduction in heart rate over time among those who practiced LKM**

Qualitative Feedback on Lovingkindness Meditation

- Helped patients relax, slow down, center, balance, find a safe space

- Helped patients think more positively, practice acceptance, reduce worry thoughts/anxiety, think clearly, and feel more positive and connected to others

- Helped patients distract from pain and feel less pain (related to treatment)

- Helped patients cope during medical appointments (e.g., prior to sentinel lymph node biopsy/surgery, surgical evaluations, chemotherapy) & with cancer-related news (e.g., receipt of a result)

Overall, this study offered preliminary evidence that a brief lovingkindness meditation protocol can improve emotional distress and negative physical symptoms during the peri-surgical period of breast cancer, as well as increase positive psychosocial resources.

Future Implications

Research

Clinical Practice

Acknowledgments

- Francis Keefe, Ph.D.
- Rebecca Shelby, Ph.D.
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- Timothy Strauman, Ph.D.
- Clive Robins, Ph.D.
- Jeffrey Brantley, M.D.
- All of the patients who dedicated their time to this study

Questions

Study Flow

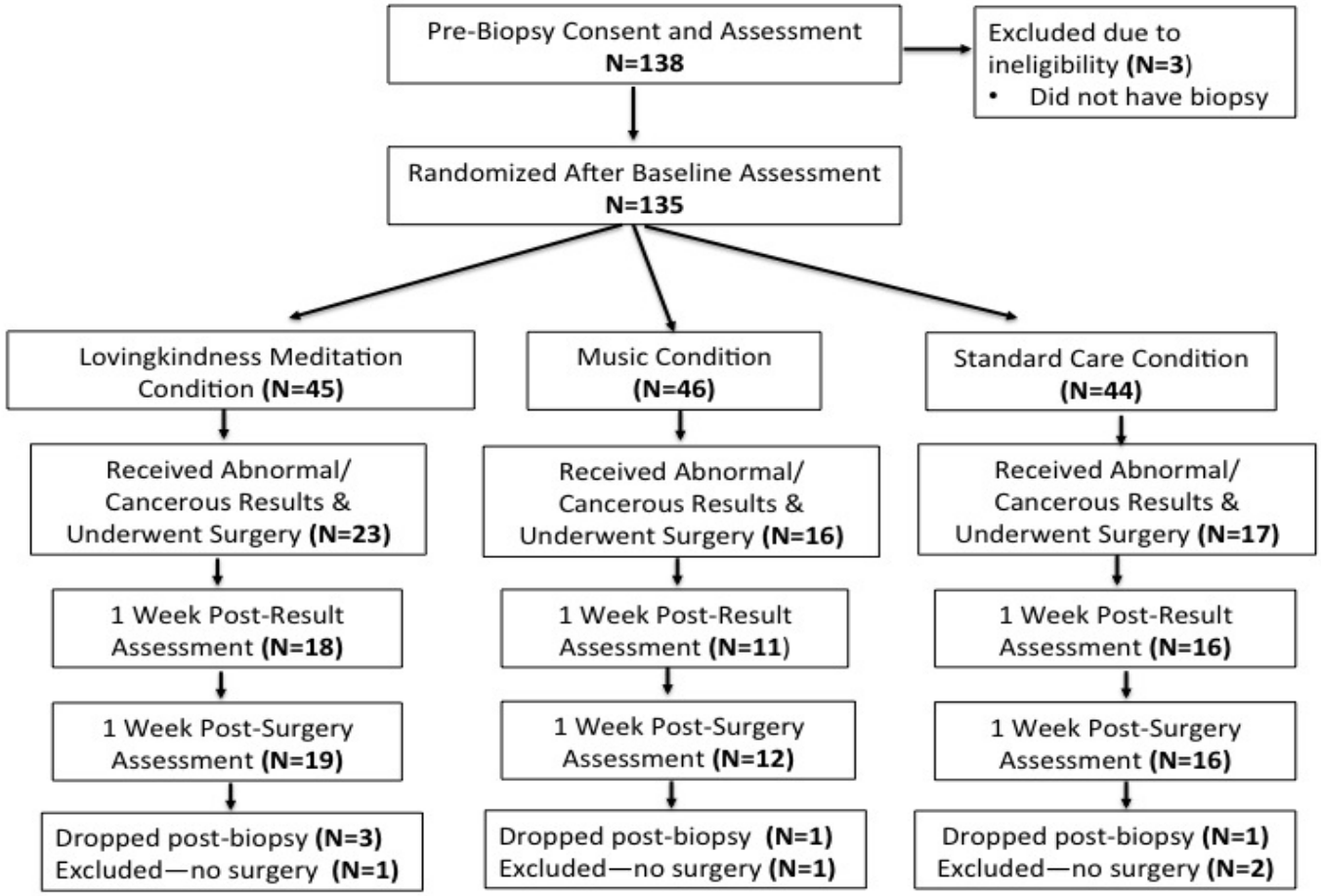

Pre-Biopsy Consent and Assessment
N=138
Excluded due to ineligibility (N=3)
• Did not have biopsy
Randomized After Baseline Assessment
N=135
Lovingkindness Meditation Condition (N=45)
Music Condition (N=46)
Standard Care Condition (N=44)
Received Abnormal/ Cancerous Results & Underwent Surgery (N=23)
Received Abnormal/ Cancerous Results & Underwent Surgery (N=16)
Received Abnormal/ Cancerous Results & Underwent Surgery (N=17)
1 Week Post-Result Assessment (N=18)
1 Week Post-Result Assessment (N=11)
1 Week Post-Result Assessment (N=16)
1 Week Post-Surgery Assessment (N=19)
1 Week Post-Surgery Assessment (N=12)
1 Week Post-Surgery Assessment (N=16)
Dropped post-biopsy (N=3)
Excluded—no surgery (N=1)
Dropped post-biopsy (N=1)
Excluded—no surgery (N=1)
Dropped post-biopsy (N=1)
Excluded—no surgery (N=2)

Table 2

Table 2: Descriptive statistics of pre-treatment demographic and medical factors by treatment condition

Characteristic	Lovingkindness Meditation Intervention Group (N=23)	Music Active Control Group (N=16)	Standard Care Attention Control Group (N=17)	F or $\chi 2$ value	*P* value
Age, mean (SD)	57.61 (11.87)	57.31 (7.53)	52.35(13.03)	F = 1.24	0.30
Race				$\chi 2$=7.19	0.13
White	19 (49%)	11 (28%)	9 (23%)		
African American	3 (25%)	4 (33%)	5 (42%)		
Asian	2 (100%)				
Marital Status				$\chi 2$=1.51	0.47
Married/Partner	12 (38%)	10 (31%)	10 (31%)		
Education				$\chi 2$=6.03	0.64
High School Graduate	2 (67%)		1 (33%)		
Partial College	4 (36%)	4 (36%)	3 (27%)		
4-yr College Graduate	8 (50%)	4 (25%)	4 (25%)		
Partial Graduate School	1 (20%)	2 (40%)	2 (40%)		
Graduate Degree	3 (23%)	3 (23%)	7 (54%)		
Total Years of Education	15.62 (3.02)	15.93 (2.34)	15.27 (3.75)	F = 0.17	0.85
Biopsy Type				$\chi 2$=1.01	0.58

Table 2

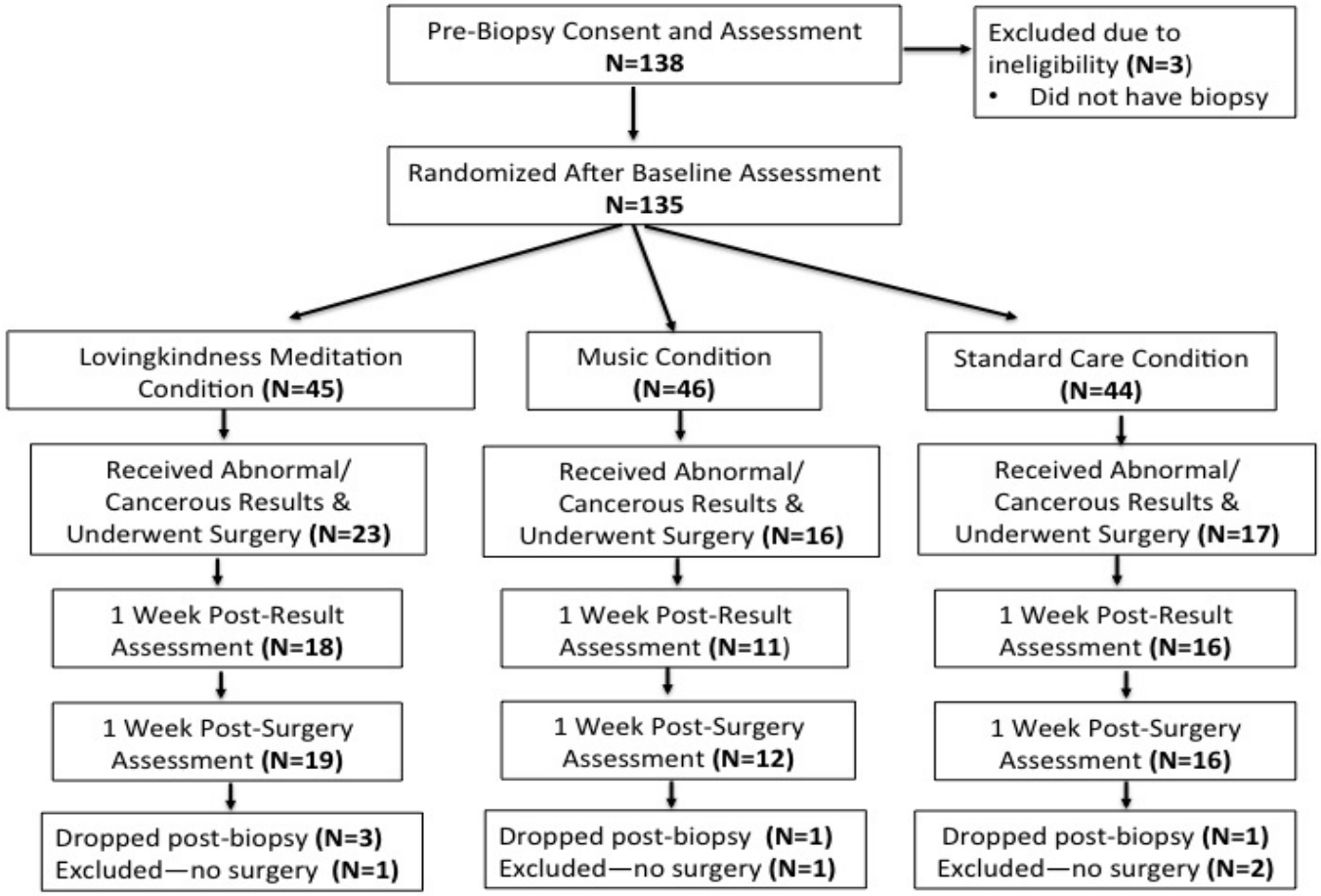
Characteristic	Lovingkindness Meditation Intervention Group (N=23)	Music Active Control Group (N=16)	Standard Care Attention Control Group (N=17)	F or $\chi 2$ value	*P* value
Ultrasound	14 (37%)	11 (29%)	13 (34%)		
Stereotactic	9 (50%)	5 (28%)	4 (22%)		
Breast Biopsy History	17 (40%)	13 (30%)	13 (30%)	$\chi 2$=0.23	0.89
Brest Surgery History	4 (21%)	9 (47%)	6 (32%)	$\chi 2$=6.38	0.04
Cancer Diagnosis Prior to Biopsy	3 (27%)	5 (46%)	3 (27%)	$\chi 2$ = 2.04	0.36
First Degree Relative with Breast Cancer	6 (50%)	5 (42%)	1 (8%)	$\chi 2$=3.44	0.18
Comorbid History	1.55 (1.37)	1.87 (1.6)	1.29 (1.76)	F = 0.54	0.59
History of Anxiety/Depression	6 (60%)	2 (20%)	2 (20%)	$\chi 2$=1.81	0.41

Table 3

Table 3: Descriptive statistics of surgical factors by treatment condition

Characteristic	Lovingkindness Meditation Intervention Group (N=23)	Music Active Control Group (N=16)	Standard Care Attention Control Group (N=17)	F or $\chi 2$ value	*P* value
Surgery Type				$\chi 2 = 1.73$	0.42
Excisional Biopsy/ Lumpectomy	13 (36%)	10 (28%)	13 (36%)		
Mastectomy with or without Reconstruction	10 (50%)	6 (30%)	4 (20%)		
Surgical Location				$\chi 2 = 5.67$	0.23
Right	8 (35%)	6 (26%)	9 (39%)		
Left	11 (44%)	10 (40%)	4 (16%)		
Bilateral Surgery	3 (60%)		2 (40%)		
Additional Surgeries for Positive Margins	3 (43%)	2 (29%)	2 (29%)	$\chi 2 = 0.02$	0.99
Lymph Node/Axillary Node Surgical Dissection	15 (46%)	9 (27%)	9 (27%)	$\chi 2 = 0.68$	0.71
Neoadjuvant Chemotherapy	4 (31%)	6 (46%)	3 (23%)	$\chi 2 = 2.57$	0.28

Study Flow


Pre-Biopsy Consent and Assessment
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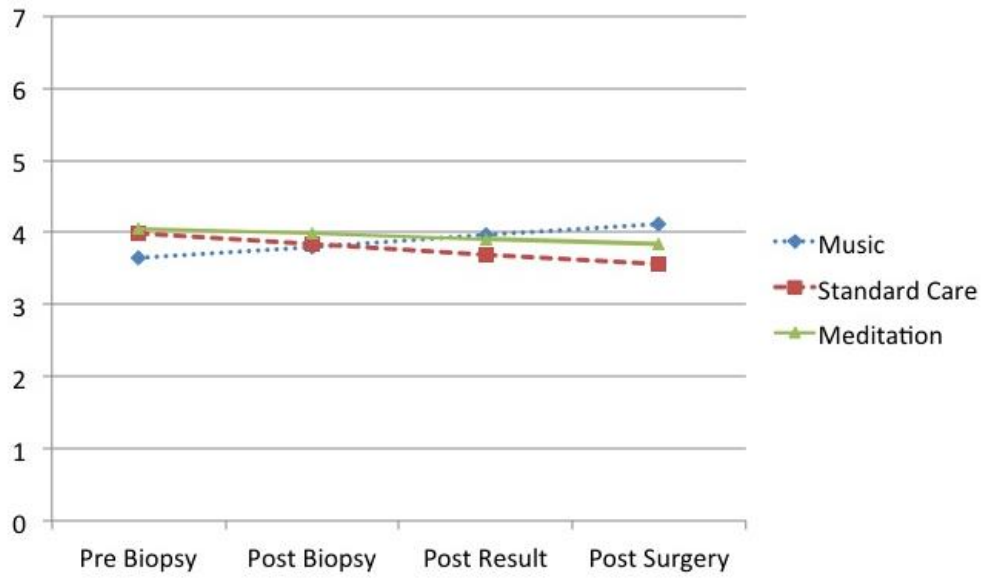
Results: Exploratory Outcomes

Emotional Suppression

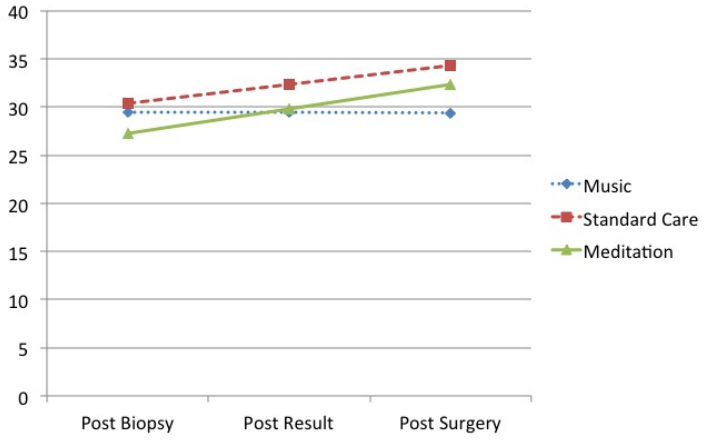
Significant treatment x time interaction (*B*=-0.23, *SE*=0.12, *t*=-1.85, *p*=0.07)



Results: Exploratory Outcomes

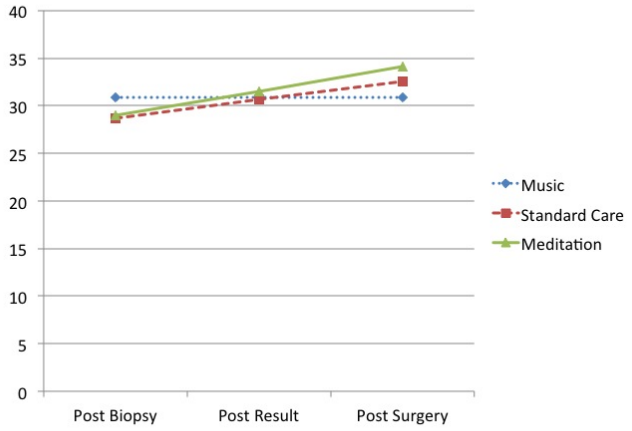
Mindful Awareness

Significant treatment x time interaction (*B*=-2.57, *SE*=1.00, *t*=-2.56, *p*=0.01)



Mindful Non-Judgment

Significant treatment x time interaction (*B*=-2.58, *SE*=1.25, *t*=-2.07, *p*=0.04)



Results: Exploratory Outcomes

Social Isolation

Significant treatment x time interaction (*B*=1.89, *SE*=0.88, *t*=2.15, *p*=0.04)

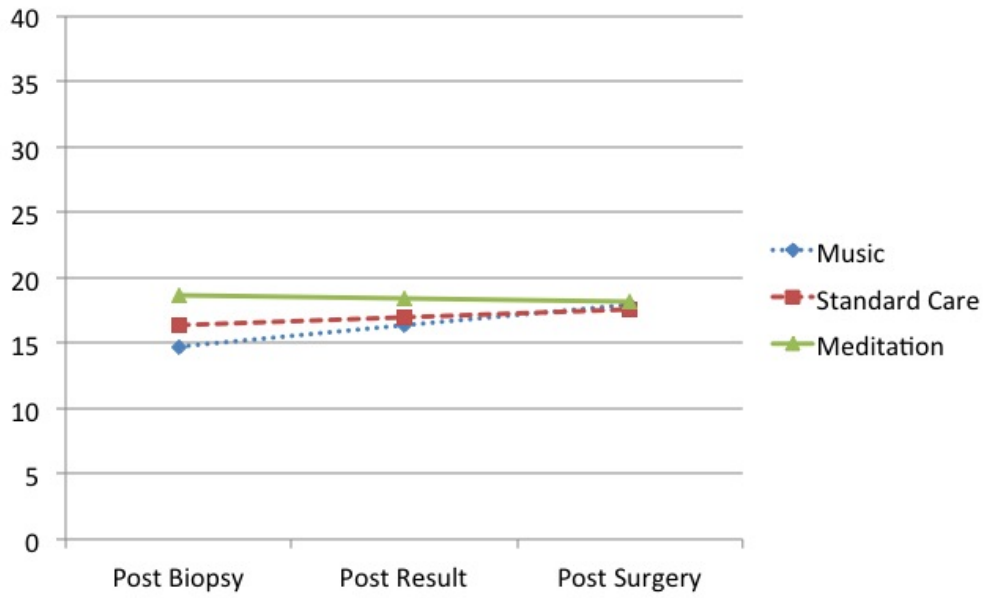


Table 2

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Characteristic	Lovingkindness Meditation Intervention Group (N=23)	Music Active Control Group (N=16)	Standard Care Attention Control Group (N=17)	F or $\chi 2$ value	*P* value
Age, mean (SD)	57.61 (11.87)	57.31 (7.53)	52.35(13.03)	F = 1.24	0.30
Race				$\chi 2$=7.19	0.13
White	19 (49%)	11 (28%)	9 (23%)		
African American	3 (25%)	4 (33%)	5 (42%)		
Asian	2 (100%)				
Marital Status				$\chi 2$=1.51	0.47
Married/Partner	12 (38%)	10 (31%)	10 (31%)		
Education				$\chi 2$=6.03	0.64
High School Graduate	2 (67%)		1 (33%)		
Partial College	4 (36%)	4 (36%)	3 (27%)		
4-yr College Graduate	8 (50%)	4 (25%)	4 (25%)		
Partial Graduate School	1 (20%)	2 (40%)	2 (40%)		
Graduate Degree	3 (23%)	3 (23%)	7 (54%)		
Total Years of Education	15.62 (3.02)	15.93 (2.34)	15.27 (3.75)	F = 0.17	0.85
Biopsy Type				$\chi 2$=1.01	0.58

Table 2

Characteristic	Lovingkindness Meditation Intervention Group (N=23)	Music Active Control Group (N=16)	Standard Care Attention Control Group (N=17)	F or $\chi 2$ value	*P* value
Ultrasound	14 (37%)	11 (29%)	13 (34%)		
Stereotactic	9 (50%)	5 (28%)	4 (22%)		
Breast Biopsy History	17 (40%)	13 (30%)	13 (30%)	$\chi 2$=0.23	0.89
Brest Surgery History	4 (21%)	9 (47%)	6 (32%)	$\chi 2$=6.38	0.04
Cancer Diagnosis Prior to Biopsy	3 (27%)	5 (46%)	3 (27%)	$\chi 2$ = 2.04	0.36
First Degree Relative with Breast Cancer	6 (50%)	5 (42%)	1 (8%)	$\chi 2$=3.44	0.18
Comorbid History	1.55 (1.37)	1.87 (1.6)	1.29 (1.76)	F = 0.54	0.59
History of Anxiety/Depression	6 (60%)	2 (20%)	2 (20%)	$\chi 2$=1.81	0.41

Table 3

Table 3: Descriptive statistics of surgical factors by treatment condition

Characteristic	Lovingkindness Meditation Intervention Group (N=23)	Music Active Control Group (N=16)	Standard Care Attention Control Group (N=17)	F or $\chi 2$ value	*P* value
Surgery Type				$\chi 2 = 1.73$	0.42
Excisional Biopsy/ Lumpectomy	13 (36%)	10 (28%)	13 (36%)		
Mastectomy with or without Reconstruction	10 (50%)	6 (30%)	4 (20%)		
Surgical Location				$\chi 2 = 5.67$	0.23
Right	8 (35%)	6 (26%)	9 (39%)		
Left	11 (44%)	10 (40%)	4 (16%)		
Bilateral Surgery	3 (60%)		2 (40%)		
Additional Surgeries for Positive Margins	3 (43%)	2 (29%)	2 (29%)	$\chi 2 = 0.02$	0.99
Lymph Node/Axillary Node Surgical Dissection	15 (46%)	9 (27%)	9 (27%)	$\chi 2 = 0.68$	0.71
Neoadjuvant Chemotherapy	4 (31%)	6 (46%)	3 (23%)	$\chi 2 = 2.57$	0.28

Table 4

Table 4: Descriptive statistics for outcome measures at the pre-biopsy assessment by treatment condition

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Positive Mood	6-24			
Pre-biopsy		15.13 (3.61)	12.21 (4.83)	12.44 (2.9)
Negative Mood	6-24			
Pre-biopsy		8.79 (2.33)	11.94 (5.37)	9.86 (3.81)
Anxiety	20-80			
Pre-biopsy		41.72 (11.35)	47.26 (17.35)	43.82 (12.3)
Body Pain	0-10			
Pre-biopsy		1.81 (2.05)	1.87 (2.56)	1.29 (1.44)
Pain Unpleasantness	0-10			
Pre-biopsy		2.05 (2.21)	2.00 (2.48)	1.29 (1.83)
Breast Pain	0-10			
Pre-biopsy		0.45 (0.87)	1.09 (1.97)	0.68 (1.17)
Vasovagal Symptoms	0-10			
Pre-biopsy		0.46 (1.16)	0.80 (1.56)	0.78 (1.58)
Fatigue	0-52			
Pre-biopsy		11.73 (8.14)	11.84 (9.82)	12.12 (9.84)
Sleep Disturbance	6-30			

Table 4

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Pre-biopsy		15.42 (6.24)	17.50 (6.08)	15.82 (5.01)
Self-Compassion	1-5			
Pre-biopsy		3.27 (0.79)	3.78 (0.76)	3.35 (0.84)
Adaptive Coping	8-32			
Post-biopsy		24.18 (4.87)	21.50 (5.61)	25.94 (4.21)
Maladaptive Coping	6-24			
Post-biopsy		8.64 (3.08)	9.38 (4.56)	8.65 (2.64)
Cognitive Appraisal	1-7			
Pre-biopsy		5.32 (0.96)	5.42 (1.27)	4.99 (1.34)
Emotional Suppression	1-7			
Pre-biopsy		3.82 (1.16)	3.25 (0.87)	3.82 (1.49)
Mindful Awareness	8-40			
Post-biopsy		27.05 (8.23)	29.00 (6.03)	29.76 (8.50)
Mindful Non-judgment	8-40			
Post-biopsy		28.41 (6.11)	30.06 (5.42)	27.12 (6.40)
Mindful Non-reactivity	8-40			
Post-biopsy		21.23 (4.59)	20.38 (3.93)	21.59 (4.21)
Emotional Support	8-40			

Table 4

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Post-biopsy		35.59 (5.85)	39.31 (2.09)	34.24 (7.37)
Social Isolation	8-40			
Post-biopsy		16.34 (7.60)	14.02 (6.09)	15.53 (6.47)
Diastolic Blood Pressure	55-96			
Pre-biopsy		87.30 (15.09)	83.13 (9.87)	77.88 (14.93)
Systolic Blood Pressure	96-179			
Pre-biopsy		142.04 (16.47)	133.33 (21.61)	130.06 (17.69)
Heart Rate	46-116			
Pre-biopsy		76.57 (13.86)	79.07 (10.78)	74.06 (9.94)

Table 5

Table 5: Descriptive statistics for outcome measures at pre-biopsy, post-biopsy, post-result, and post-surgery assessments by treatment condition

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Positive Mood	6-24			
Pre-biopsy		15.13 (3.61)	12.21 (4.83)	12.44 (2.9)
Post-biopsy		14.71 (4.14)	13.38 (4.18)	14.29 (4.58)
Post-result		15.78 (4.01)	17.18 (4.29)	15.13 (2.99)
Post-surgery		17.14 (3.72)	16.54 (5.19)	16.50 (3.33)
Negative Mood	6-24			
Pre-biopsy		8.79 (2.33)	11.94 (5.37)	9.86 (3.81)
Post-biopsy		8.64 (2.44)	10.19 (5.31)	8.24 (2.25)
Post-result		8.24 (1.93)	7.82 (2.18)	8.88 (3.91)
Post-surgery		7.21 (1.69)	8.62 (4.15)	8.06 (2.64)
Anxiety	20-80			
Pre-biopsy		41.72 (11.35)	47.26 (17.35)	43.82 (12.3)
Post-biopsy		37.84 (9.3)	43.01 (13.89)	39.71 (11.82)
Post-result		37.80 (10.32)	33.18 (11.37)	38.81 (11.11)
Post-surgery		31.66 (9.74)	37.94 (13.99)	36.63 (9.71)
Body Pain	0-10			
Pre-biopsy		1.81 (2.05)	1.87 (2.56)	1.29 (1.44)
Post-result		1.58 (1.42)	1.18 (1.42)	0.70 (0.84)

Table 5

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Post-surgery		1.84 (1.17)	2.60 (1.84)	2.33 (1.88)
Pain Unpleasantness	0-10			
Pre-biopsy		2.05 (2.21)	2.00 (2.48)	1.29 (1.83)
Post-result		1.89 (1.60)	1.45 (2.42)	0.38 (0.81)
Post-surgery		2.11 (2.28)	2.67 (2.27)	2.25 (2.70)
Breast Pain	0-10			
Pre-biopsy		0.45 (0.87)	1.09 (1.97)	0.68 (1.17)
Post- biopsy		0.77 (1.23)	1.53 (2.23)	0.35 (0.60)
Post-result		1.31 (1.34)	1.41 (1.14)	0.47 (0.76)
Post-surgery		1.94 (1.28)	2.38 (1.57)	2.47 (2.08)
Vasovagal Symptoms	0-10			
Pre-biopsy		0.46 (1.16)	0.80 (1.56)	0.78 (1.58)
Post-result		0.19 (0.33)	0.80 (1.93)	0.21 (0.68)
Post-surgery		0.46 (1.31)	0.41 (0.63)	0.21 (0.53)
Fatigue	0-52			
Pre-biopsy		11.73 (8.14)	11.84 (9.82)	12.12 (9.84)
Post-result		13.50 (11.89)	11.45 (9.18)	10.75 (8.87)
Post-surgery		13.79 (8.58)	17.46 (11.53)	15.44 (10.35)
Sleep Disturbance	6-30			
Pre-biopsy		15.42 (6.24)	17.50 (6.08)	15.82 (5.01)

Table 5

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Post-result		15.17 (5.58)	14.09 (3.73)	15.00 (6.04)
Post-surgery		15.26 (4.87)	13.65 (2.82)	14.81 (6.67)
Self-Compassion	1-5			
Pre-biopsy		3.27 (0.79)	3.78 (0.76)	3.35 (0.84)
Post-biopsy		3.36 (0.78)	3.59 (0.70)	3.50 (0.70)
Post-result		3.44 (0.83)	3.93 (0.76)	3.63 (0.72)
Post-surgery		3.78 (0.75)	3.65 (0.96)	3.60 (0.81)
Adaptive Coping	8-32			
Post-biopsy		24.18 (4.87)	21.50 (5.61)	25.94 (4.21)
Post-result		25.22 (3.66)	23.18 (5.27)	26.88 (4.47)
Post-surgery		24.47 (5.83)	25.54 (5.43)	26.81 (3.62)
Maladaptive Coping	6-24			
Post-biopsy		8.64 (3.08)	9.38 (4.56)	8.65 (2.64)
Post-result		8.00 (2.72)	7.36 (1.69)	7.75 (2.21)
Post-surgery		7.47 (2.01)	8.77 (4.68)	7.69 (2.50)
Cognitive Appraisal	1-7			
Pre-biopsy		5.32 (0.96)	5.42 (1.27)	4.99 (1.34)
Post-biopsy		5.49 (1.08)	5.31 (1.24)	4.94 (1.28)
Post-result		5.43 (1.12)	5.55 (1.14)	5.05 (1.18)
Post-surgery		5.64 (0.89)	5.82 (1.31)	5.19 (0.97)

Table 5

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Emotional Suppression	1-7			
Pre-biopsy		3.82 (1.16)	3.25 (0.87)	3.82 (1.49)
Post-biopsy		3.62 (1.27)	3.38 (0.96)	4.00 (1.57)
Post-result		3.56 (0.99)	3.43 (1.54)	3.56 (1.44)
Post-surgery		3.61 (0.88)	3.56 (1.53)	3.42 (1.25)
Mindful Awareness	8-40			
Post-biopsy		27.05 (8.23)	29.00 (6.03)	29.76 (8.50)
Post-result		28.50 (8.53)	31.82 (6.26)	31.94 (6.73)
Post-surgery		31.16 (6.55)	30.00 (6.92)	32.25 (7.24)
Mindful Non-judgment	8-40			
Post-biopsy		28.41 (6.11)	30.06 (5.42)	27.12 (6.40)
Post-result		30.44 (7.94)	34.00 (5.74)	29.75 (6.74)
Post-surgery		32.00 (6.07)	30.77 (6.86)	30.25 (7.21)
Mindful Non-reactivity	8-40			
Post-biopsy		21.23 (4.59)	20.38 (3.93)	21.59 (4.21)
Post-result		22.22 (5.06)	22.63 (5.00)	23.69 (3.72)
Post-surgery		23.11 (4.51)	22.69 (5.59)	23.63 (4.13)
Emotional Support	8-40			
Post-biopsy		35.59 (5.85)	39.31 (2.09)	34.24 (7.37)
Post-result		36.17 (6.90)	38.91 (2.47)	34.88 (7.28)

Table 5

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Post-surgery		36.79 (5.30)	38.77 (2.28)	35.00 (7.14)
Social Isolation	8-40			
Post-biopsy		16.34 (7.60)	14.02 (6.09)	15.53 (6.47)
Post-result		15.39 (7.23)	12.18 (4.12)	14.25 (5.97)
Post-surgery		14.53 (6.58)	15.08 (6.06)	14.00 (6.00)
Diastolic Blood Pressure	55-96			
Pre-biopsy		87.30 (15.09)	83.13 (9.87)	77.88 (14.93)
Post-biopsy		84.73 (12.38)	83.64 (14.39)	81.53 (6.97)
Post-result		77.05 (10.88)	74.40 (9.23)	73.06 (9.20)
Post-surgery		80.41 (8.75)	81.62 (7.30)	76.13 (6.82)
Systolic Blood Pressure	96-179			
Pre-biopsy		142.04 (16.47)	133.33 (21.61)	130.06 (17.69)
Post-biopsy		149.91 (18.63)	138.79 (18.21)	136.41 (20.31)
Post-result		140.55 (16.26)	135.07 (16.26)	127.13 (22.33)
Post-surgery		134.24 (16.58)	132.62 (18.83)	122.20 (19.68)
Heart Rate	46-116			
Pre-biopsy		76.57 (13.86)	79.07 (10.78)	74.06 (9.94)
Post-biopsy		74.09 (15.12)	77.21 (11.99)	73.88 (12.96)
Post-result		76.65 (13.43)	82.67 (12.57)	77.56 (11.66)

Table 5

Measure	Possible Score Range	Lovingkindness Meditation Intervention Group *M(SD)*	Music Active Control Group *M(SD)*	Standard Care Attention Control Group *M(SD)*
Post-surgery		75.59 (14.01)	87.31 (9.19)	83.20 (11.82)
Length of Surgery (minutes)	43-323	137.69 (64.50)	138.92 (72.47)	142.54 (81.49)
Cost of Surgery	2597-18437	7017.94 (3275.04)	5708.46 (1614.47)	6680.61 (4008.56)

Table 6

Table 6: Fixed effects for multilevel models examining the effects of lovingkindness meditation compared to music and standard care on treatment outcome variables

Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
Positive Affect	Intercept	14.76	0.79	18.78	<0.001	13.20, 16.32
	Time	0.61	0.31	1.97	0.05	-0.002, 1.22
	Music	-2.09	1.26	-1.66	0.10	-4.59, 0.41
	SC	-1.20	1.97	-1.61	0.11	-4.30,0.45
	Music × time	0.79	0.49	1.62	0.11	-0.17, 1.76
	SC × time	0.59	0.47	1.27	0.21	-0.33,1.51
Negative Affect	Intercept	9.40	0.71	13.21	<0.001	7.98, 10.81
	Time	-0.50	0.26	-1.92	0.06	-1.01, 0.01
	Music	1.77	1.06	1.67	0.10	-0.34, 3.88
	SC	0.17	1.02	0.17	0.86	-1.85, 2.20
	Music × time	-0.23	0.41	-0.55	0.58	-1.04, 0.59
	SC × time	0.04	0.39	0.10	0.92	-0.73, 0.81
Anxiety	Intercept	46.32	1.98	23.43	<0.001	42.40, 50.24
	Time	-4.05	0.87	-4.65	<0.001	-5.77, -2.33
	Music	-3.11	3.04	-1.03	0.31	-9.14, 2.90
	SC	-6.44	2.92	-2.20	0.03	-12.22, -0.65
	Music × time	1.77	1.40	1.27	0.21	-0.99, 4.53
	SC × time	2.69	1.33	2.02	0.05	0.05, 5.33
Body Pain	Intercept	1.83	0.44	4.17	<0.001	0.96, 2.71
	Time	-0.21	0.15	-1.46	0.15	-0.50, 0.08

Table 6

Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
	Music	0.05	0.64	0.08	0.94	-1.23, 1.33
	SC	-0.82	0.59	-1.37	0.17	-2.00, 0.37
	Music × time	-0.001	0.24	-0.002	0.99	-0.47, 0.47
	SC × time	0.45	0.21	2.10	0.04	0.02, 0.88
Pain Unpleasantness	Intercept	1.57	0.50	3.12	0.003	0.55, 2.59
	Time	-0.28	0.33	-0.84	0.41	-0.95, 0.39
	Music	0.03	0.77	0.04	0.97	-1.51, 1.57
	SC	-1.17	0.70	-1.66	0.10	-2.59, 0.25
	Music × time	-0.04	0.53	-0.07	0.94	-1.12, 1.04
	SC × time	0.68	0.49	1.39	0.17	-0.31, 1.67
Breast Pain	Intercept	0.33	0.32	1.02	0.31	-0.32, 0.96
	Time	0.49	0.13	3.64	0.001	0.22, 0.76
	Music	0.80	0.51	1.56	0.13	-0.23, 1.83
	SC	-0.11	0.49	-0.22	0.83	-1.10, 0.88
	Music × time	-0.09	0.21	-0.42	0.68	-0.52, 0.34
	SC × time	0.07	0.20	0.32	0.75	-0.34, 0.48
Fatigue	Intercept	12.05	2.31	5.21	<0.001	7.40, 16.70
	Time	0.37	0.69	0.54	0.59	-1.01, 1.75
	Music	-2.89	3.51	-0.82	0.42	-9.95, 4.17
	SC	-3.82	3.24	-1.18	0.24	-10.33, 2.70
	Music × time	0.63	1.12	0.56	0.58	-1.61, 2.86
	SC × time	0.69	1.04	0.67	0.51	-1.39, 2.77
Sleep Disturbance	Intercept	16.10	1.22	13.18	<0.001	13.65, 18.55

Table 6

Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
	Time	-0.28	0.44	-0.63	0.53	-1.16, 0.60
	Music	0.24	1.98	0.12	0.90	-3.72, 4.21
	SC	-1.64	1.90	-0.86	0.39	-5.45, 2.17
	Music × time	-0.91	0.70	-1.31	0.20	-2.32, 0.49
	SC × time	-0.01	0.67	-0.02	0.99	-1.37, 1.34
Self-Compassion	Intercept	3.40	0.16	21.62	<0.001	3.08, 3.71
	Time	0.16	0.05	3.59	0.001	0.07, 0.25
	Music	0.46	0.24	1.96	0.06	-0.02, 0.94
	SC	0.32	0.22	1.45	0.16	-0.13, 0.76
	Music × time	-0.22	0.07	-3.00	0.004	-0.36, -0.07
	SC × time	-0.09	0.07	-1.35	0.18	-0.23, 0.05
Adaptive Coping	Intercept	23.89	1.11	21.53	<0.001	21.65, 26.12
	Time	0.23	0.79	0.29	0.77	-1.36, 1.82
	Music	-1.84	1.77	-1.04	0.31	-5.41, 1.73
	SC	2.19	1.70	1.29	0.20	-1.23, 5.61
	Music × time	1.48	1.26	1.17	0.25	-1.08, 4.04
	SC × time	0.21	1.21	0.18	0.86	-2.23, 2.66
Maladaptive Coping	Intercept	9.11	0.73	12.49	<0.001	7.64, 10.58
	Time	-0.84	0.43	-1.93	0.06	-1.72, 0.04
	Music	0.04	1.17	0.04	0.97	-2.30, 2.39
	SC	-0.88	1.12	-0.79	0.43	-3.13, 1.36
	Music × time	0.75	0.69	1.09	0.28	-0.64, 2.15
	SC × time	0.56	0.66	0.85	0.40	-0.78, 1.91

Table 6

Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
Cognitive Appraisal	Intercept	4.89	0.43	11.30	<0.001	4.02, 5.76
	Time	0.42	0.13	3.10	0.003	0.15, 0.69
	Music	0.49	0.43	1.14	0.26	-0.38, 1.35
	SC	0.14	0.42	0.32	0.75	-0.71, 0.99
	Music × time	-0.11	0.13	-0.85	0.40	-0.38, 0.15
	SC × time	-0.24	0.13	-1.81	0.08	-0.51, 0.03
Emotional Suppression	Intercept	4.05	0.27	15.07	<0.001	3.51, 4.59
	Time	-0.07	0.08	-0.85	0.40	-0.22, 0.09
	Music	-0.41	0.41	-1.00	0.32	-1.22, 0.41
	SC	-0.07	0.39	-0.18	0.86	-0.85, 0.71
	Music × time	0.23	0.12	1.85	0.07	-0.02, 0.47
	SC × time	-0.07	0.12	-0.60	0.55	-0.30, 0.16
Mindful Awareness	Intercept	27.26	2.47	11.04	<0.001	22.30, 32.22
	Time	2.53	0.63	4.01	<0.001	1.28, 3.78
	Music	2.22	2.52	0.88	0.38	-2.83, 7.26
	SC	3.11	2.44	1.28	0.21	-1.77, 7.99
	Music × time	-2.57	1.00	-2.56	0.01	-4.56, -0.57
	SC × time	-0.57	0.97	-0.59	0.56	-2.51, 1.36
Mindful Non-judgment	Intercept	28.95	1.35	21.45	<0.001	26.26, 31.64
	Time	2.58	0.77	3.36	0.001	1.05, 4.10
	Music	1.89	2.25	0.84	0.40	-2.59, 6.38
	SC	-0.29	2.07	-0.14	0.89	-4.41, 3.83
	Music × time	-2.58	1.25	-2.07	0.04	-5.07, -0.10

Table 6

Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
	SC × time	-0.61	1.16	-0.52	0.60	-2.92, 1.70
Mindful Non-reactivity	Intercept	21.36	1.24	17.21	<0.001	18.88, 23.84
	Time	1.25	0.53	2.36	0.02	0.19, 2.30
	Music	-1.15	1.71	-0.68	0.50	-4.56, 2.26
	SC	1.06	1.63	0.65	0.52	-2.19, 4.32
	Music × time	-0.25	0.84	-0.30	0.76	-1.93, 1.42
	SC × time	-0.51	0.80	-0.63	0.53	-2.11, 1.09
Emotional Support	Intercept	29.90	1.98	15.14	<0.001	25.99, 33.82
	Time	1.11	1.56	0.71	0.48	-1.99, 4.21
	Music	2.85	1.96	1.46	0.15	-1.03, 6.72
	SC	-0.47	1.79	-0.26	0.79	-4.00, 3.07
	Music × time	-0.29	1.52	-0.19	0.85	-3.30, 2.73
	SC × time	0.16	1.42	0.11	0.91	-2.66, 2.97
Social Isolation	Intercept	18.71	1.71	10.92	<0.001	15.25, 22.16
	Time	-0.27	0.53	-0.50	0.62	-1.34, 0.81
	Music	-3.97	2.25	-1.76	0.09	-8.50, 0.56
	SC	-2.37	1.98	-1.20	0.24	-6.35, 1.62
	Music × time	1.89	0.88	2.15	0.04	0.12, 3.66
	SC × time	0.88	0.77	1.14	0.26	-0.68, 2.44
Diastolic Blood Pressure	Intercept	86.01	2.44	35.26	<0.001	81.16, 90.86
	Time	-2.89	0.98	-2.95	0.004	-4.82, -0.96
	Music	-4.95	3.95	-1.25	0.21	-12.80, 2.91
	SC	-8.05	3.70	-2.18	0.03	-15.39, -0.71

Table 6

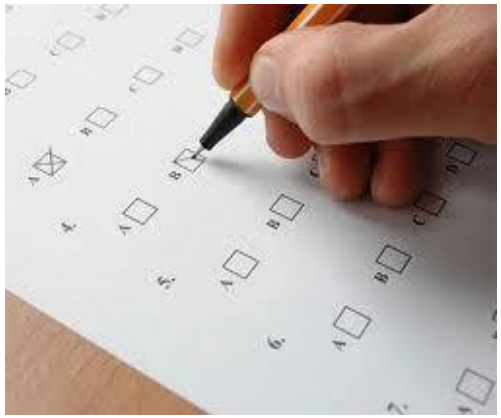
Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
	Music × time	1.19	1.56	0.76	0.45	-1.89, 4.27
	SC × time	1.77	1.49	1.19	0.24	-1.17, 4.71
Systolic Blood Pressure	Intercept	144.79	3.67	39.42	<0.001	137.40, 152.19
	Time	-2.40	1.57	-1.53	0.13	-5.57, 0.76
	Music	-6.85	6.04	-1.13	0.26	-19.00, 5.31
	SC	-5.56	5.69	-0.98	0.33	-17.02, 5.90
	Music × time	0.81	2.52	0.32	0.75	-4.26, 5.87
	SC × time	-1.40	2.40	-0.58	0.56	-6.24, 3.44
Heart Rate	Intercept	78.15	2.84	27.47	<0.001	72.42, 83.87
	Time	-0.40	1.06	-0.38	0.71	-2.55, 1.74
	Music	-1.41	4.59	-0.31	0.76	-10.65, 7.82
	SC	-6.31	4.33	-1.46	0.15	-15.04, 2.42
	Music × time	4.24	1.70	2.50	0.02	0.81, 7.68
	SC × time	3.31	1.61	2.05	0.05	0.05, 6.57

Table 7

Table 7: Fixed effects for multilevel models examining the effects of lovingkindness meditation practice on treatment outcome variables

Outcome	Fixed effect	*B*	SE	*t*	*P*	95% CI
Anxiety	Intercept	37.70	3.74	10.08	<0.001	30.07, 45.33
	Time	1.90	1.96	0.97	0.34	-2.08, 5.89
	Practice	0.74	1.28	0.58	0.57	-1.88, 3.36
	Time × Practice	-2.14	0.69	-3.09	0.004	-3.54, -0.73
Emotional Suppression	Intercept	3.43	0.46	7.38	<0.001	2.48, 4.37
	Time	0.36	0.17	2.12	0.05	<0.001, 0.72
	Practice	0.07	0.16	0.45	0.66	-0.25, 0.40
	Time × Practice	-0.14	0.06	-2.35	0.03	-2.66, -0.01
Heart Rate	Intercept	70.27	6.07	11.57	<0.001	57.55, 82.99
	Time	6.24	2.42	2.57	0.02	1.09, 11.38
	Practice	1.73	2.12	0.82	0.43	-2.72, 6.18
	Time × Practice	-1.94	0.83	-2.34	0.03	-3.70, -0.18

Study Measures



Mood

Anxiety

Body Pain

Breast Pain

Vasovagal Symptoms

Fatigue

Sleep Disturbance

Self-Compassion

Coping

Emotion Regulation

Mindfulness

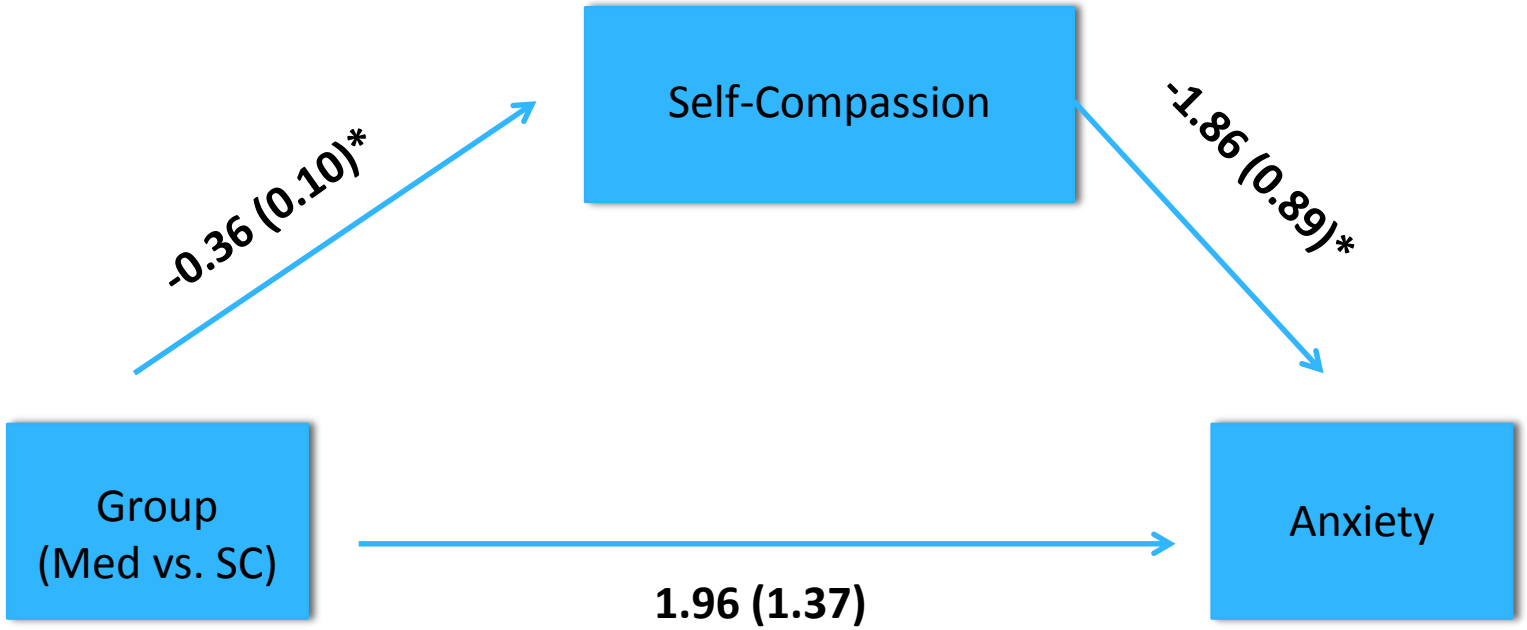
Social Support

Physiological Reactivity

Surgery Variables

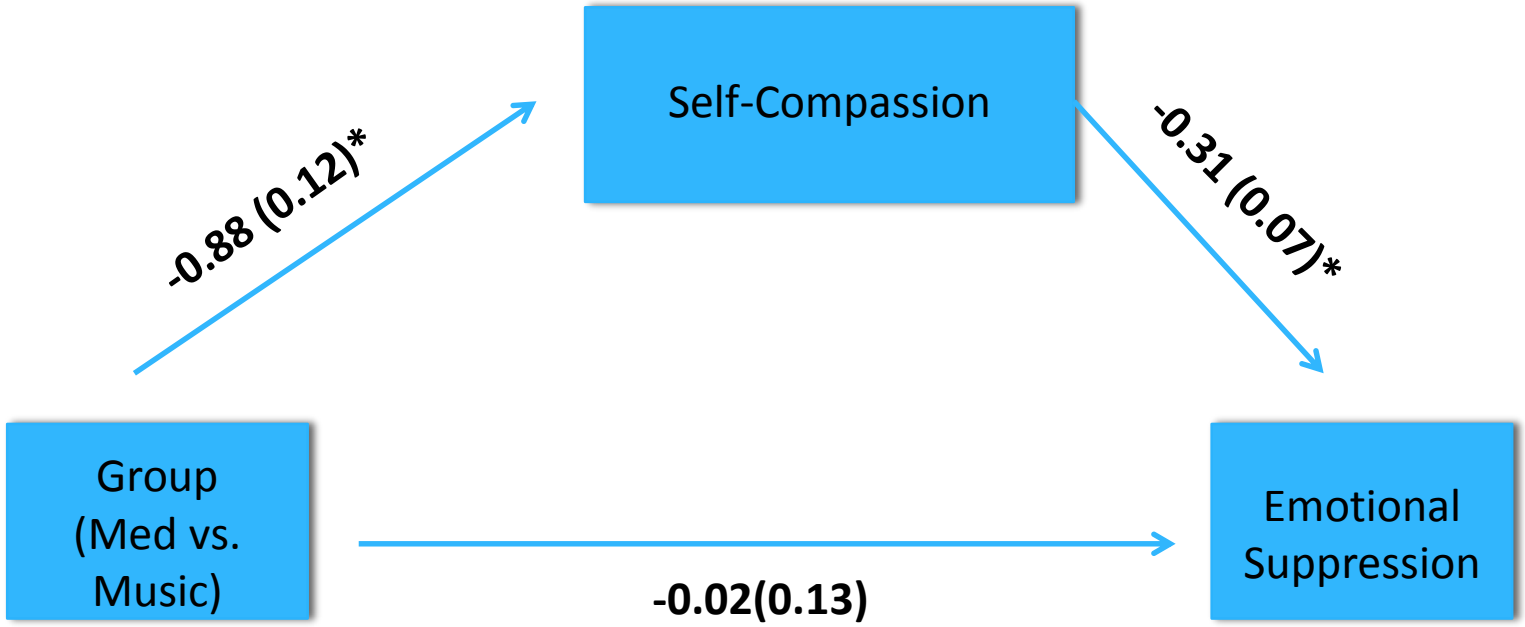
Adherence

Mediation Model Anxiety



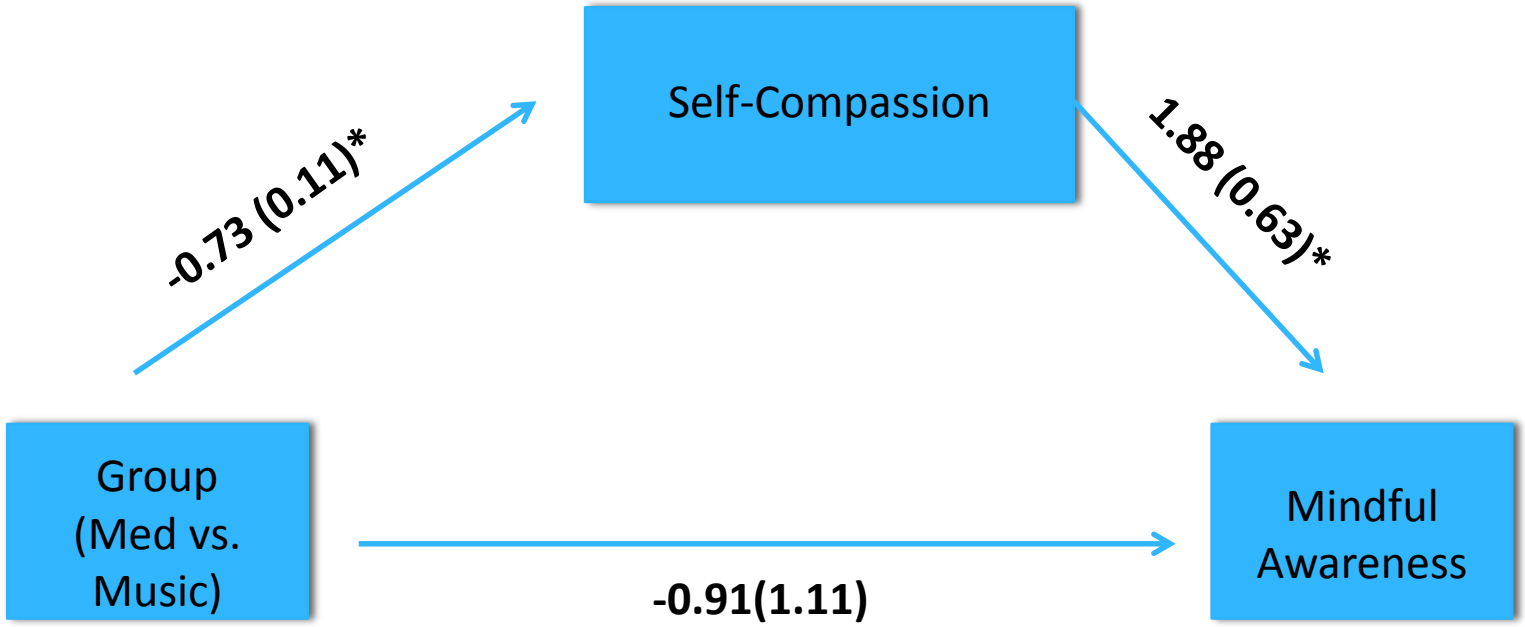
Indirect Effect: z=1.81, p=0.07
(Trend for mediation)

Mediation Model
Emotional Suppression



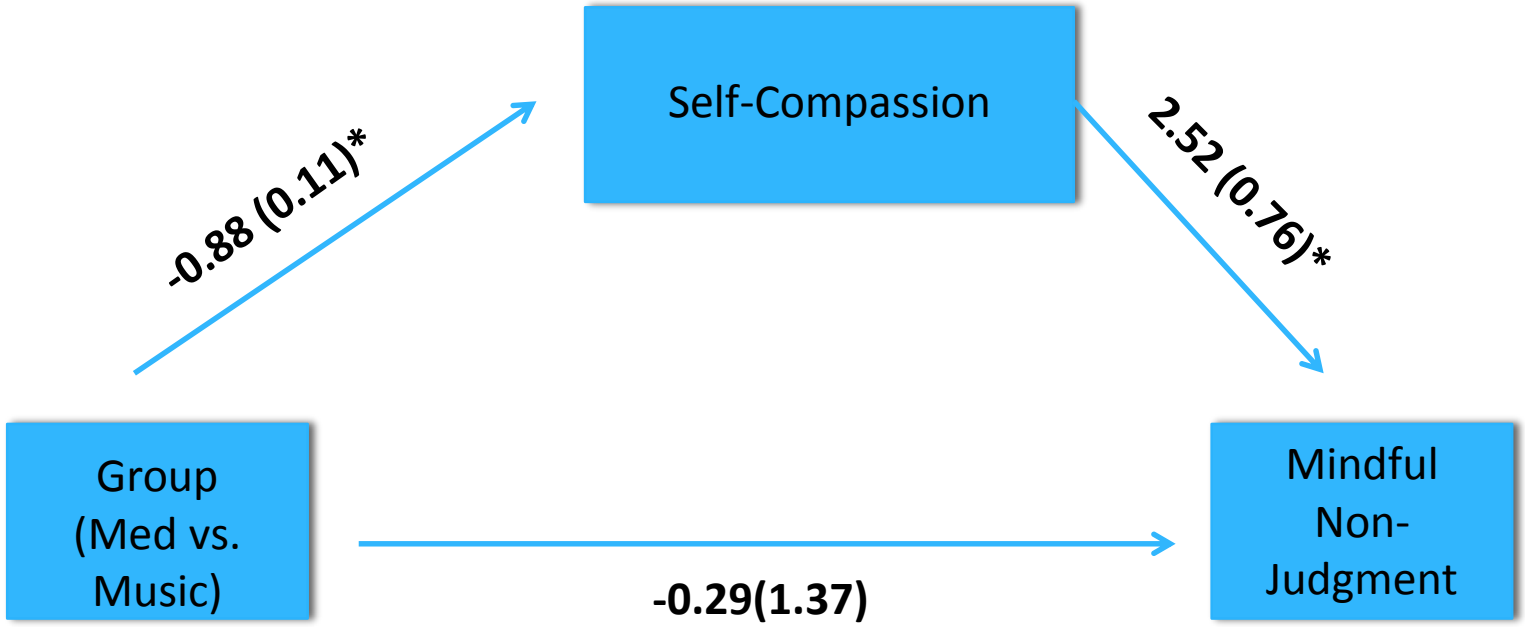
Indirect Effect: z=3.79, p<0.001
(Suggests mediation)

Mediation Model Mindful Awareness



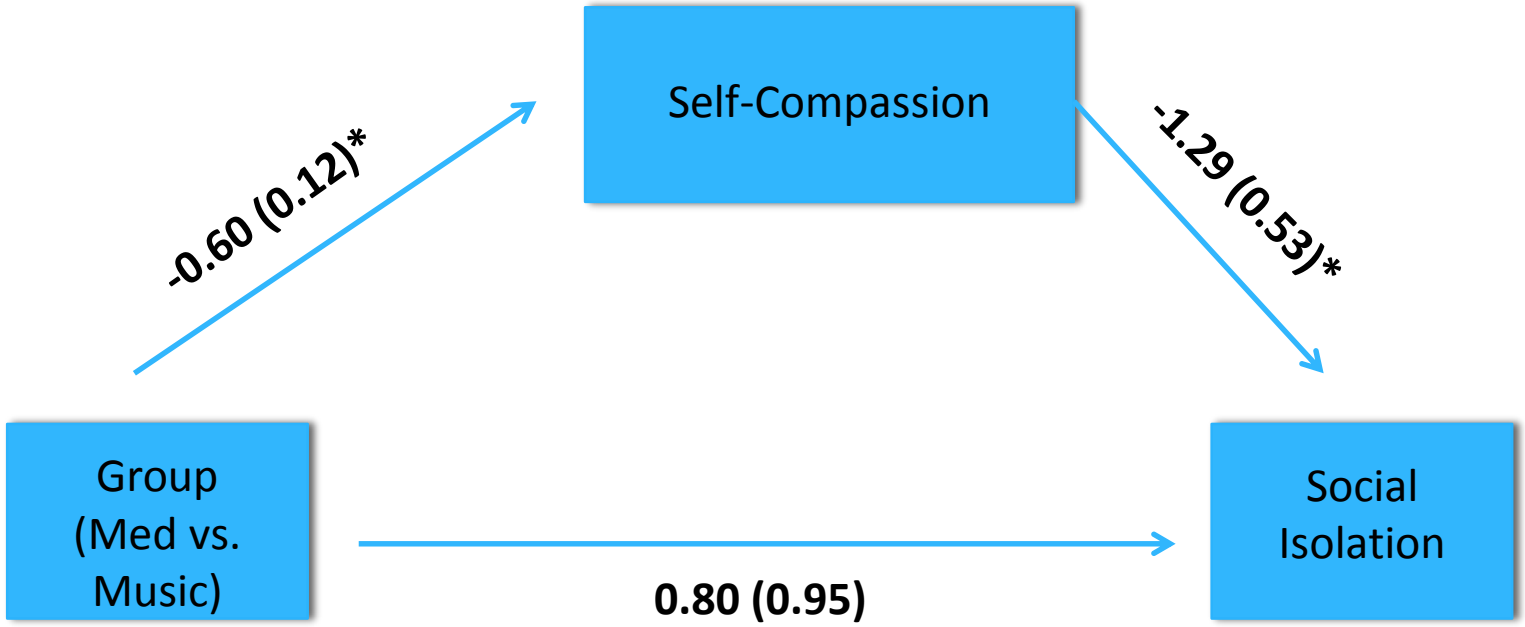
Indirect Effect: z=-2.72, p=0.01
(Suggests mediation)

Mediation Model
Mindful Non-Judgment



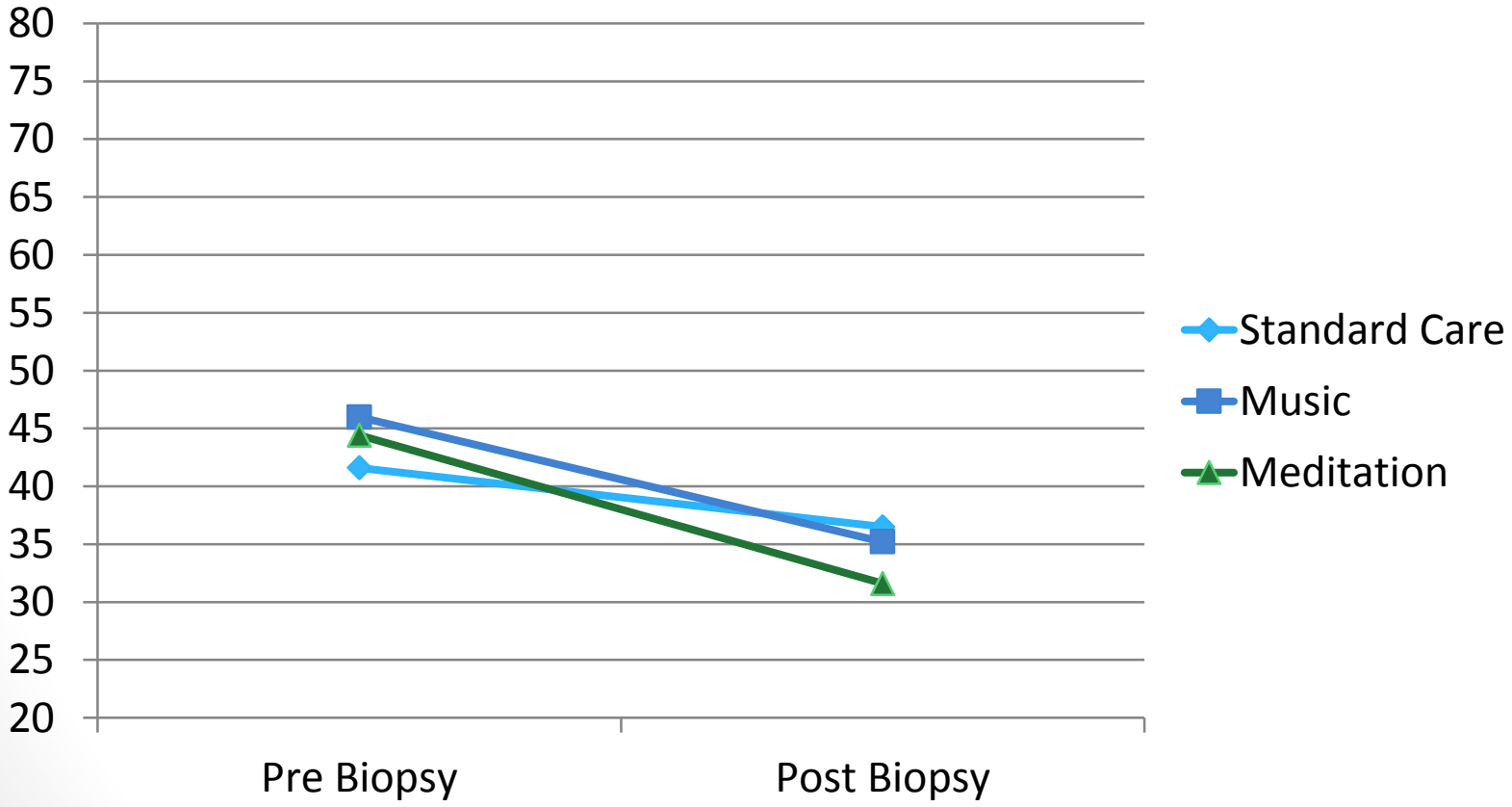
Indirect Effect: z=-3.06, p=0.002
(Suggests mediation)

Mediation Model Social Isolation

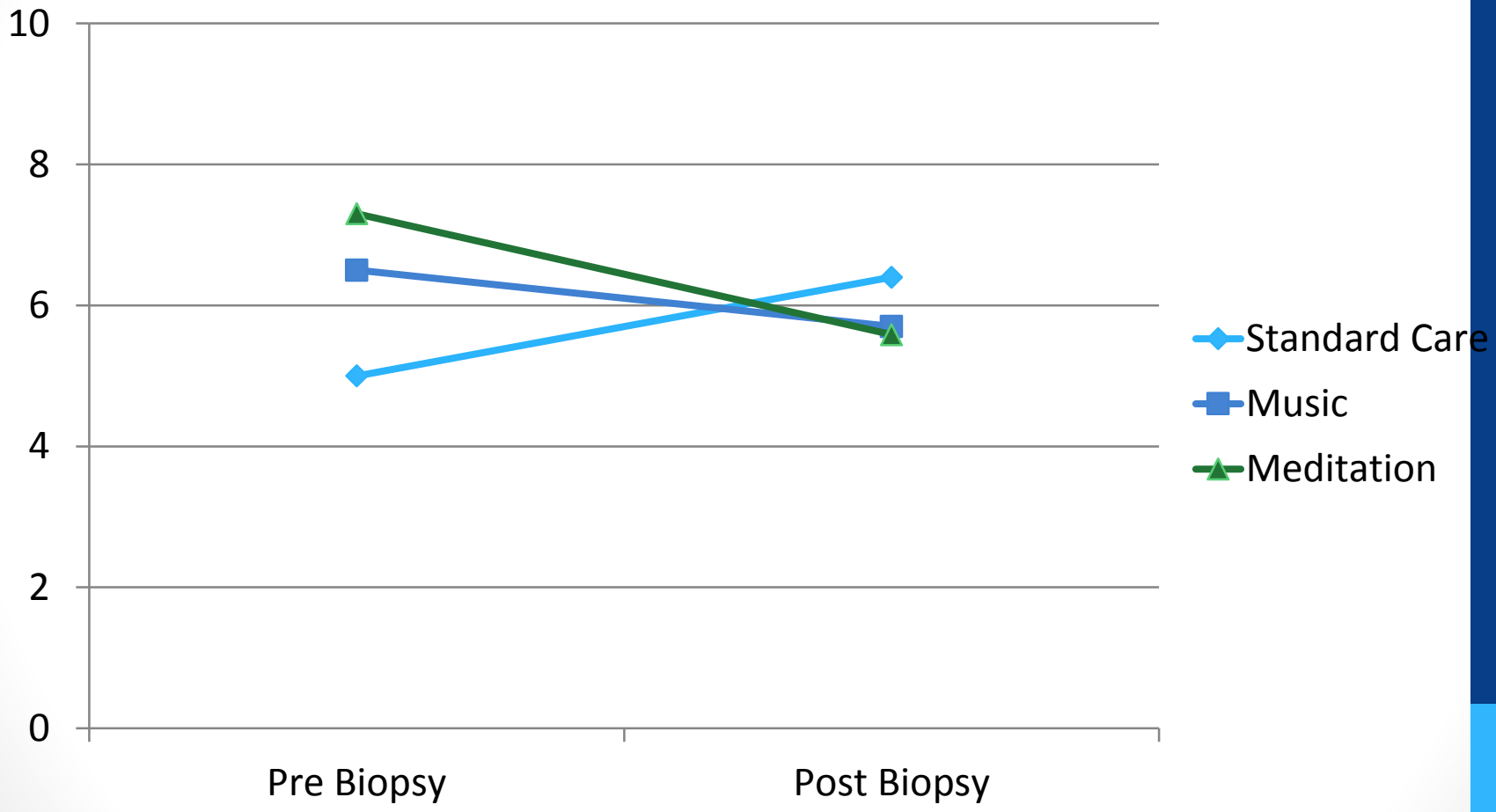


Indirect Effect: z= 2.19, p=0.02
(Suggests mediation)

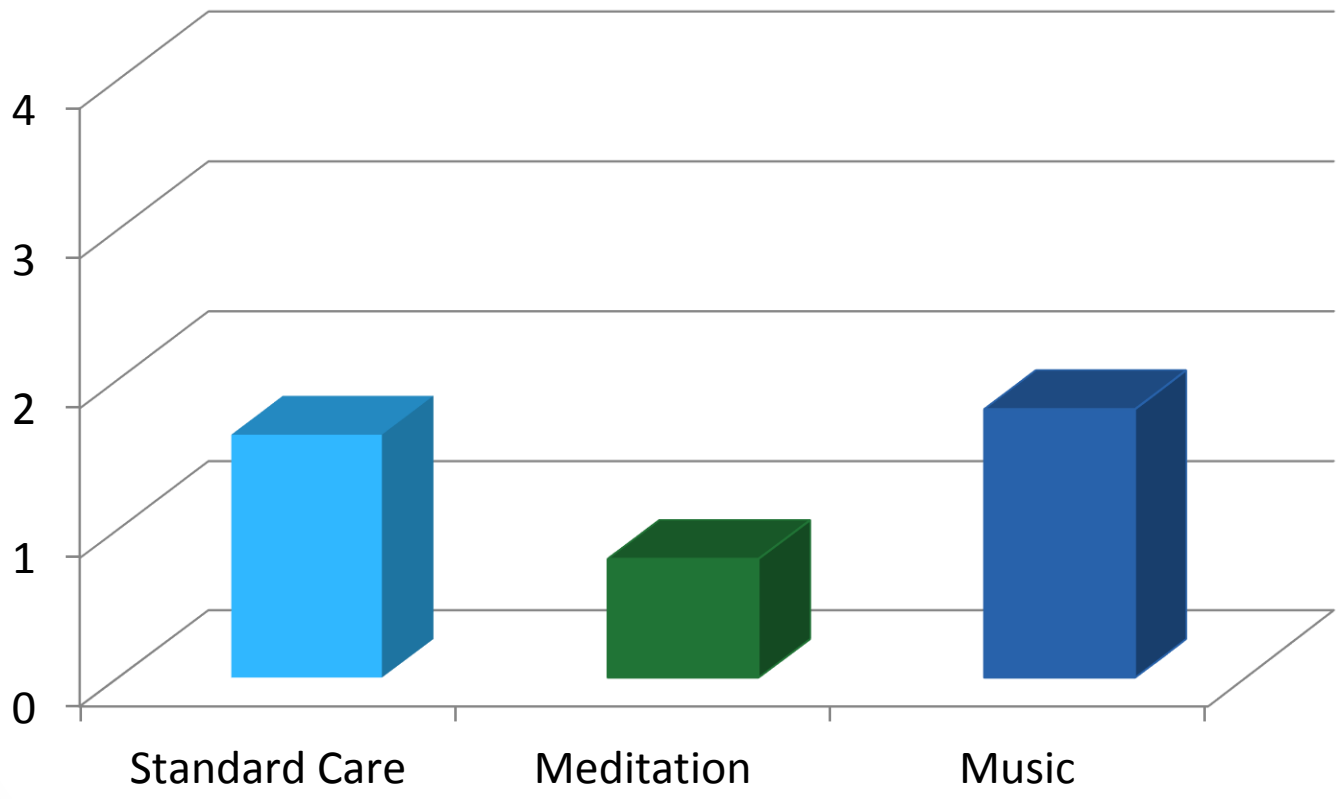
Day of Biopsy Outcomes
STAI State Anxiety



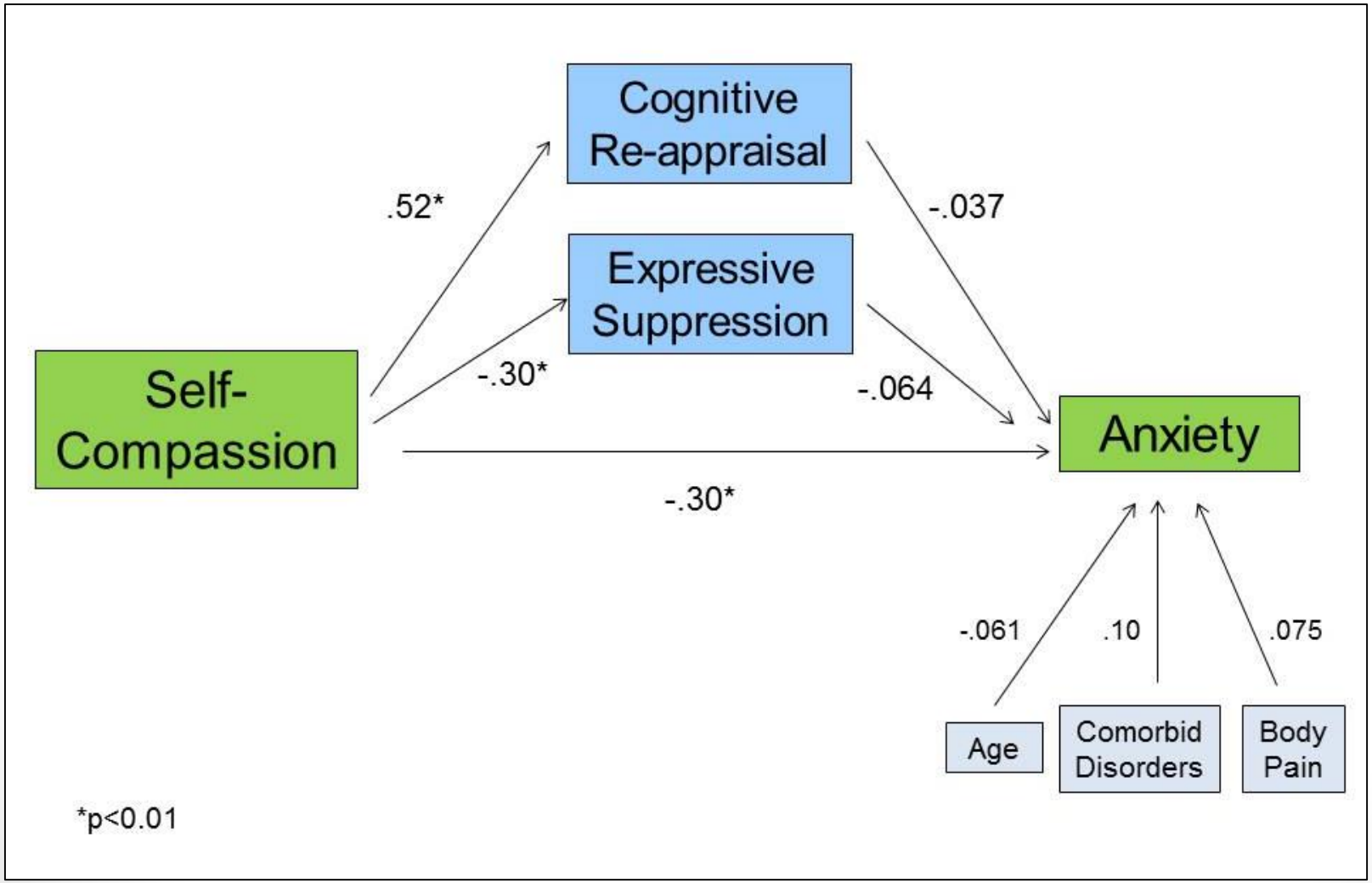
Day of Biopsy Outcomes Fatigue



Day of Biopsy Outcomes Biopsy Pain

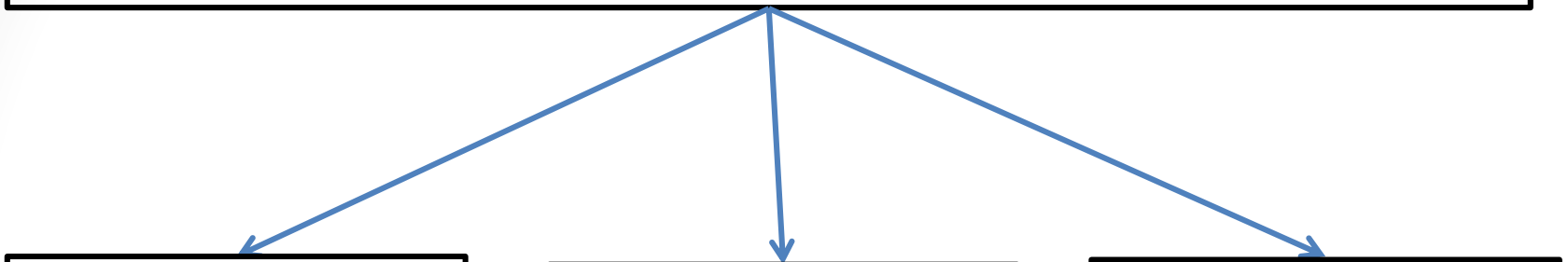


The Breast Biopsy Experience: Relationship between Anxiety, Anticipatory Pain and Psychological Variables



Study Variable	Measure	Description of Measure	Time Points	Reliability and Validity References	Appendix Page #'s
Mood	Cohen's Positive and Negative Mood Scale	Measures positive and negative mood	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Cohen et al., 2006	p. 1
Anxiety	State Anxiety Scale of the State-Trait Anxiety Inventory	Measures state level of anxiety	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Speilberger, 1983	p. 2
Body Pain	Brief Pain Inventory-Intensity Scale; Pain Unpleasantness; Pain Duration	Measures pain intensity and unpleasantness, and duration of bodily pain	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Cleeland & Ryan, 1994; Jensen, Karoly, & Braver, 1986; Price, et al., 1983	p. 3-4
Breast Pain	Ongoing Breast Pain; Continuing Breast Pain	Measures ongoing and continuing breast pain	Baseline, Post-Result, Post-Surgery	N/A—Designed for study	p. 5
Nausea	Nausea Scale	Measures nausea	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Montgomery et al., 2007	p. 6
Fatigue	FACIT Fatigue	Measures fatigue	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Reese, Shelby, & Abernethy, 2011	p. 7
Sleep Disturbance	PROMIS Sleep Disturbance	Brief measure of sleep disturbance	Pre-Biopsy, Post-Result, Post-Surgery	Buysse et al., 2010	p. 8
Physiological Reactivity	Blood Pressure and Heart Rate	Physiologic measures of blood pressure and pulse	Baseline, Post-Biopsy, Pre-Surgery, Post-Surgery; Surgical Follow-Up Visit	N/A	N/A
Self-Compassion	Self-Compassion Scale Short-Form	Brief measure of self-compassion	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Neff et al., 2005; Neff, 2003	p. 9
Coping	Brief COPE	Measure of coping	Post-Biopsy, Post-Result, Post-Surgery	Dougall et al., 2009	p. 10
Emotion Regulation	Emotion Regulation Questionnaire	Measure of emotion regulation	Baseline, Post-Biopsy, Post-Result, Post-Surgery	Gross & John, 2003	p. 11
Mindfulness	Five Facet Mindfulness Questionnaire	Measure of mindfulness	Post-Biopsy, Post-Result, Post-Surgery	Baer et al., 2008	p. 12
Social Support	PROMIS Social Isolation, PROMIS Emotional Support	Two measures of social support	Post-Biopsy, Post-Result, Post-Surgery	(Cella et al., 2007; Reeve et al., 2007	p. 13-14
Health Care Utilization	Electronic Patient Records	Measure of pain medication use during surgery, length of surgery, and cost of care	Pre- to Post-Surgery (During Hospital Visit)	N/A	N/A
Adherence	Adherence Measure	Measures Adherence	Post-Result, Post-Surgery	N/A—Designed for study	p. 15

Effects of Positive Emotions in the Context of Breast Cancer Surgery



Undoing Effect

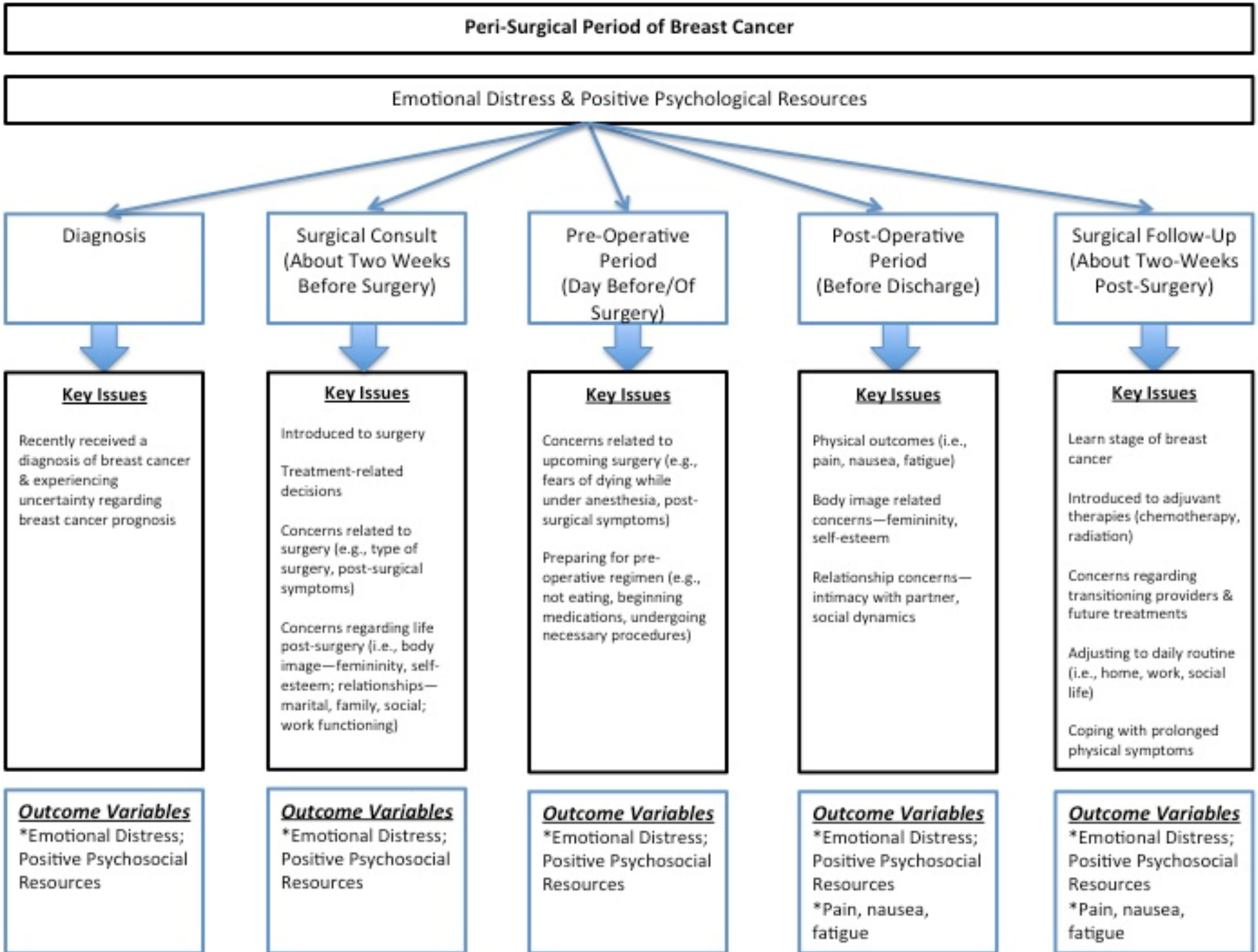
- Decreased emotional distress, physiological reactivity (e.g., blood pressure, heart rate)
- Decreased negative physical symptoms (i.e., pain, nausea, fatigue, sleep disturbance)

Broadening Effect

- Utilization of a broader coping repertoire

Building Effect

- Increased self-compassion
- Increased coping repertoire
- Increased emotion regulation
- Increased mindfulness
- Increased social support
- Decreased physical symptoms


Peri-Surgical Period of Breast Cancer
Emotional Distress & Positive Psychological Resources
Diagnosis
Surgical Consult (About Two Weeks Before Surgery)
Pre-Operative Period (Day Before/Of Surgery)
Post-Operative Period (Before Discharge)
Surgical Follow-Up (About Two-Weeks Post-Surgery)
Key Issues
Recently received a diagnosis of breast cancer & experiencing uncertainty regarding breast cancer prognosis
Key Issues
Introduced to surgery
Treatment-related decisions
Concerns related to surgery (e.g., type of surgery, post-surgical symptoms)
Concerns regarding life post-surgery (i.e., body image—femininity, self-esteem; relationships—marital, family, social; work functioning)
Key Issues
Concerns related to upcoming surgery (e.g., fears of dying while under anesthesia, post-surgical symptoms)
Preparing for pre-operative regimen (e.g., not eating, beginning medications, undergoing necessary procedures)
Key Issues
Physical outcomes (i.e., pain, nausea, fatigue)
Body image related concerns—femininity, self-esteem
Relationship concerns—intimacy with partner, social dynamics
Key Issues
Learn stage of breast cancer
Introduced to adjuvant therapies (chemotherapy, radiation)
Concerns regarding transitioning providers & future treatments
Adjusting to daily routine (i.e., home, work, social life)
Coping with prolonged physical symptoms
Outcome Variables
*Emotional Distress; Positive Psychosocial Resources
Outcome Variables
*Emotional Distress; Positive Psychosocial Resources
Outcome Variables
*Emotional Distress; Positive Psychosocial Resources
Outcome Variables
*Emotional Distress; Positive Psychosocial Resources
*Pain, nausea, fatigue
Outcome Variables
*Emotional Distress; Positive Psychosocial Resources
*Pain, nausea, fatigue

Key Points from Review: *Section 1*

- Empirical literature has demonstrated that:
  - Emotional distress in peri-surgical period has predicted **negative adjustment** post-surgery (e.g., emotional distress, pain, nausea, fatigue, discomfort, immune changes, analgesic use)
  - Positive psychosocial resources in the peri-surgical period (e.g., optimism, hope, positive coping variables) have predicted **positive adjustment** (i.e., improvement in emotional distress, well-being, immune markers)

Key Points from Review: *Section 2*

- **Psychosocial peri-surgical interventions**
  - Strengths:
    - Preliminary efficacy and feasibility data
  - Limitations:
    - Lack of theoretical focus
    - Lack of emphasis on positive psychosocial resources

- **Post-surgical interventions: CBT & MBSR**
  - Strengths:
    - Focus on cultivation/assessment of positive psychosocial resources
    - Efficacy data
  - Limitations:
    - Length of intervention

Key Points from Review: *Section 3*

- Fredrickson's Broaden-and-Build theory indicates positive emotions may provide a valuable conceptual framework for psychosocial peri-surgical interventions for breast cancer patients

- Lovingkindness meditation (LKM)-based peri-surgical protocol could lead to the cultivation of positive emotions
  - Research has demonstrated initial efficacy of LKM interventions in healthy and clinical populations
  - Research has shown initial efficacy of a brief LKM intervention