Increased Anterior Commissure Integrity After MBSR Training Relates to Improved Describing Ability

Submission Number:

2450

Submission Type:

Abstract Submission

Authors:

Chang-Le Chen[1], Yao-Chia Shih[2], Tzung-Kuen Wen[3], Shih-Chin Fang[4], Da-Lun Tang[5], Si-Chen Lee[6], Wen-Yih Isaac Tseng[7,8]

Institutions:

[1]Graduate Institute of Brain and Mind Sciences, National Taiwan University College of Medicine, Taipei City, Taiwan, [2]Institute of Biomedical Engineering, National Taiwan University, Taipei City, Taiwan, [3]Department of Buddhist Studies, Dharma Drum Institute of Liberal Arts, New Taipei City, Taiwan, [4]Department of Neurology, Cardinal Tien Hospital Yonghe Branch, New Taipei City, Taiwan, [5]Department of Mass Communication, Tamkang University, Taipei City, Taiwan, [6]Department of Electrical Engineering, National Taiwan University, Taipei City, Taiwan, [7]Institute of Medical Device and Imaging, National Taiwan University College of Medicine, Taipei City, Taiwan, [8]Molecular Imaging Center, National Taiwan University, Taipei City, Taiwan

Introduction:

Mindfulness-based stress reduction (MBSR) is an 8-week systematic meditation training aiming for non-judgemental insight to present moment experience. Researchers have investigated the beneficial effects of MBSR and the underlying neuro-mechanism.[1] Most studies have reported gray matter changes and their correlations with the psychological effects.[2,3] Few studies investigated the change in white matter structure, especially after the short-term mindfulness training. Here, we aimed to investigate the correlation between tract integrity and psychological change induced by short-term MBSR training.

Methods:

Fifteen healthy adult novices (Age= 44±11yrs, gender= 5 male, 10 female) participated the training program. Twenty-four healthy adults who didn't receive the program were recruited as the control group. MRI examination was performed on a 3T MRI system. T1-weighted imaging utilized a MPRAGE pulse sequence (TR=2000 ms, TE=3 ms, flip angle= 9^o, FOV=256×256 mm^2, resolution=1×1×1 mm^3). DSI utilized a pulsed gradient twice-refocused spin-echo echo planar imaging sequence using 102 diffusion encoding gradients with the maximum diffusion sensitivity b_{max}=4000 s/mm^2. (TR=9600 ms, TE=130 ms, FOV=200×200 mm^2, matrix size= 80×80, slice thickness=2.5 mm). We applied four psychological questionnaires: Lipp's stress symptom inventory (SSI), Beck anxiety and depression inventory (BAI, BDI) and five facet mindfulness questionnaire (FFMQ) in Chinese version which involved five independent facets, namely observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience.[4] We used whole brain tract-based automatic analysis to calculate generalized fractional anisotropy (GFA) profiles of 76 white matter tract bundles for each DSI dataset.[5] Pair t test was calculated to compare the difference in mean GFA of each tract bundle between the pre- and post- training conditions. We used nonparametric Wilcoxon signed rank test for SSI, BAI and BDI and pair t test for FFMQ for comparisons. We calculated partial correlation, age and gender as regressors, to assess the correlations between the GFA changes and the changes in psychological questionnaires. Bonferroni correction was used to address multiple comparisons.

Results:

Three white matter tracts, right auditory radiation (p= 2.9 × 10^-4), anterior commissure (p= 2.38 × 10^-7) and posterior commissure (p= 1.56 × 10^-4), showed significant increase in GFA after the program.(Fig.1) There was significant difference in BAI (p= 0.03), BDI (p= 0.008)(Fig.2) and 4 out of 5 FFMQ facets (observing: p= o.o12, describing: p= 0.022, acting with awareness: p= 0.014, non-reactivity: p= 0.021).(Fig.3) The scores commonly decreased in SSI, BAI, BDI and increased in FFMQ after the program. A high positive correlation (r= 0.712, p= 0.003) was found between the GFA change of the anterior commissure and the change in the describing facet of FFMQ.

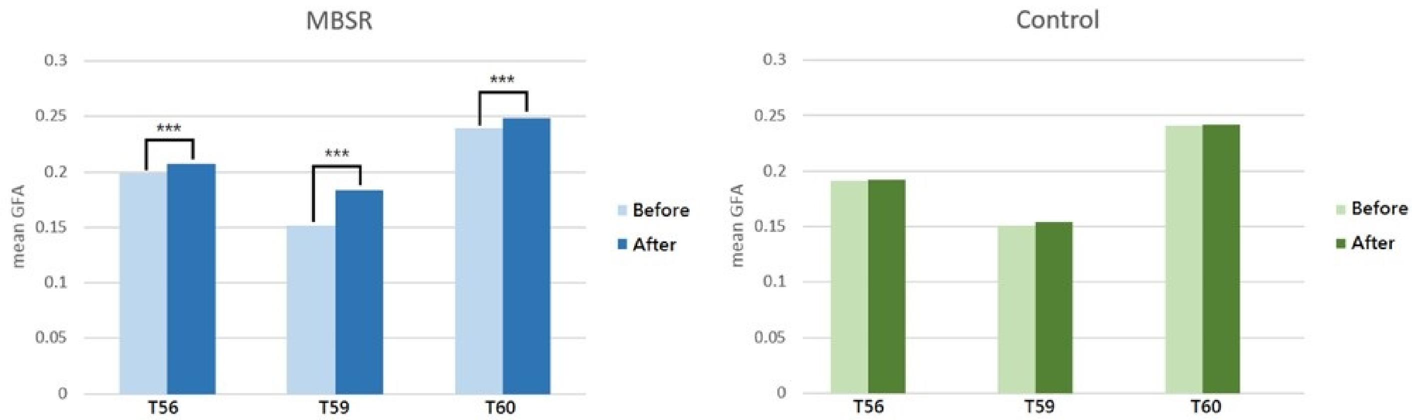

Figure 1. X axis shows three tract bundles before and after MBSR training. Y axis shows the mean GFA value. After short-term MBSR training, the GFA value significantly increased in right auditory radiation (T56), anterior commissure (T59) and posterior commissure (T60), whereas no significant difference was found in the control group.

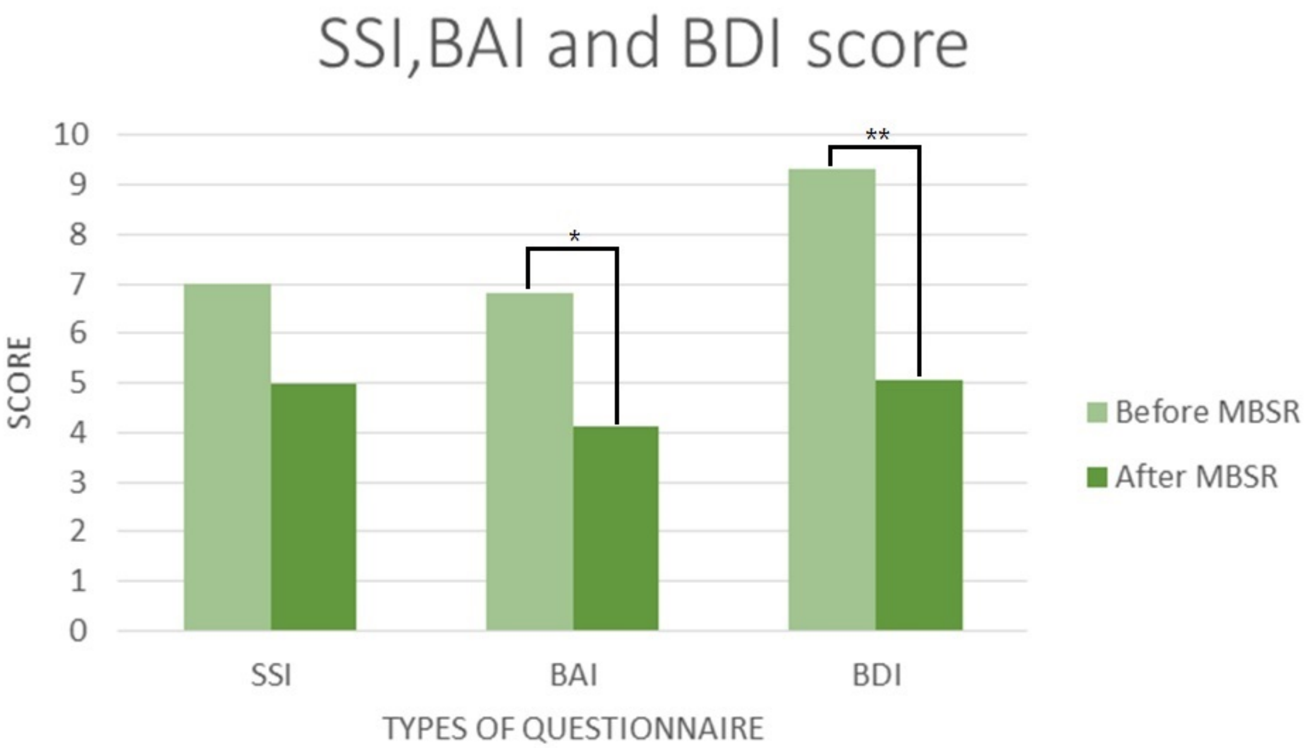

Figure 2. X axis shows three psychological questionnaires administered before and after MBSR training. Y axis shows the scores of each questionnaire. After MBSR training, the scores of psychological questionnaires commonly decreased and showed significant decrease in BAI and BDI, indicating improvement of the subjects' mental health after MBSR.

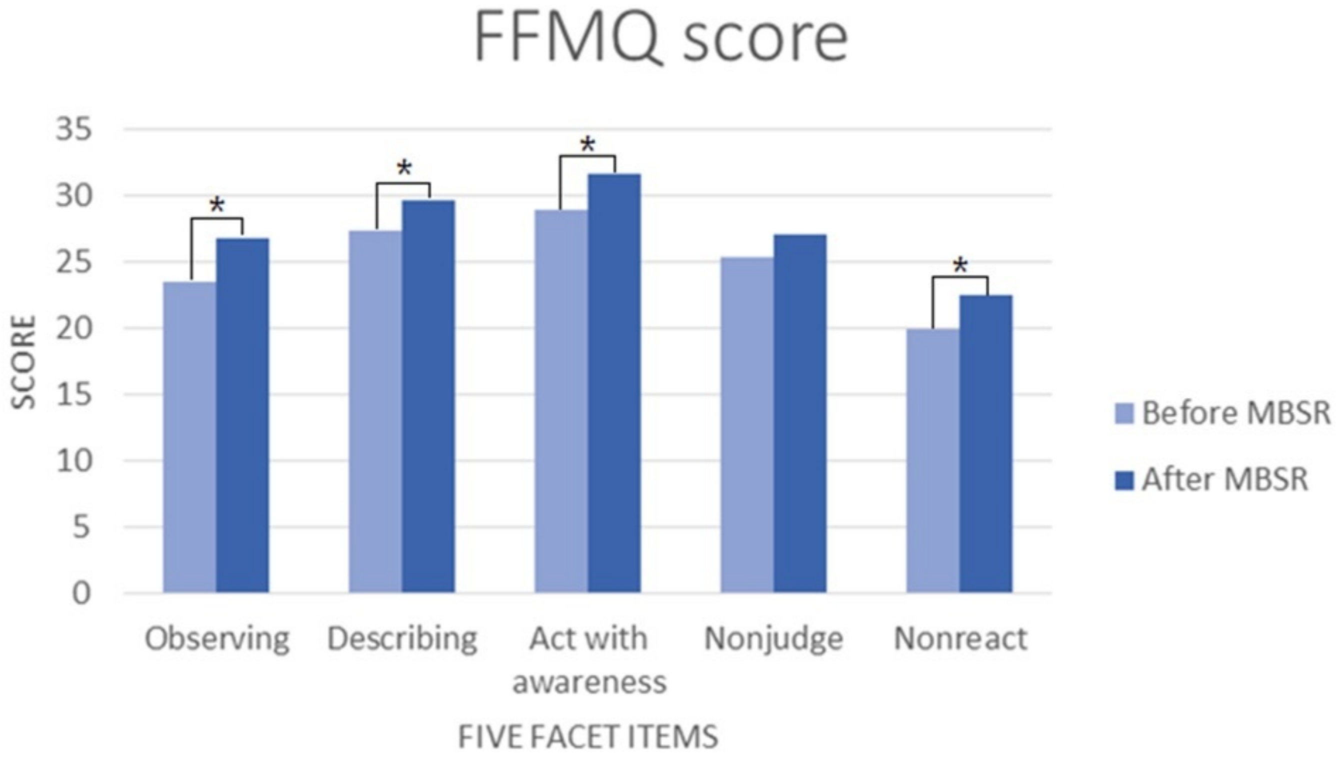

Figure 3. X axis shows five different facets of FFMQ before and after MBSR training. Y axis shows the scores of each facet. After MBSR training, the scores of five facets commonly increased, and statistical significance was found in all facets except nonjudging facet. It indicates that MBSR training can improve the subjects' mindfulness skills.

Conclusions:

Three tract bundles and 3 psychological questionnaires were significantly modulated by short-term MBSR training. MBSR training reduced the subjects' anxiety and depression and enhanced the mindfulness skills. The GFA change of the anterior commissure was highly associated with the change in the describing facet in FFMQ which meant noting or mentally identifying internal experiences with words. Previously, the describing facet in FFMQ was correlated with gray matter volume in the right parahippocampal gyrus/amygdala.[6] In fact, the posterior limb of the anterior commissure connects bilateral amygdala, parahippocampal gyrus and peripheral temporal cortex.[7] This anatomical correspondence supports our partial correlation results. In summary, the altered white matter tract bundles and the enhancement of mental health may be induced by short-term MBSR training. The anterior commissure might be a neural substrate of the improved describing ability in MBSR.

Imaging Methods:

Diffusion MRI [2]

Perception and Attention:

Consciousness and Awareness

Social Neuroscience:

Self Processes [1]

Keywords:

WHITE MATTER IMAGING - DTI, HARDI, DSI, ETC
Other - Mindfulness-Based Stress Reduction (MBSR) ; Anterior Commissure ; Five Facet Mindfulness Questionnaire (FFMQ)

[1|2]Indicates the priority used for review

Would you accept an oral presentation if your abstract is selected for an oral session?

Yes

I would be willing to discuss my abstract with members of the press should my abstract be marked newsworthy:

No

Please indicate below if your study was a "resting state" or "task-activation" study.

Other

Healthy subjects only or patients (note that patient studies may also involve healthy subjects):

Healthy subjects

Internal Review Board (IRB) or Animal Use and Care Committee (AUCC) Approval. Please indicate approval below. Please note: Failure to have IRB or AUCC approval, if applicable will lead to automatic rejection of abstract.

Yes, I have IRB or AUCC approval

Please indicate which methods were used in your research:

Diffusion MRI
Structural MRI
Behavior

For human MRI, what field strength scanner do you use?

3.0T

Which processing packages did you use for your study?

Other, Please list - Tract-Based Automatic Analysis (TBAA)

Provide references in author date format

1. Tang, Y. Y. et al. (2015), 'The neuroscience of mindfulness meditation', Nature Reviews Neuroscience, vol. 16, no. 4, pp. 213-225.
2. Farb, N. A. et al. (2012), 'Mindfulness meditation training alters cortical representations of interoceptive attention', Social cognitive and affective neuroscience, nss066.
3. Hölzel, B. K. et al. (2009), 'Stress reduction correlates with structural changes in the amygdala', Social cognitive and affective neuroscience, nsp034.
4. Deng, Y. Q. et al. (2011), 'The five facet mindfulness questionnaire: psychometric properties of the Chinese version', Mindfulness, vol. 2, no. 2, pp. 123-128.
5. Chen, Y. J. et al. (2015), 'Automatic whole brain tract-based analysis using predefined tracts in a diffusion spectrum imaging template and an accurate registration strategy', Human brain mapping, vol. 36, no. 9, pp. 3441-3458.
6. Murakami, H. et al. (2012), 'The structure of mindful brain', PloS one, vol. 7, no. 9, pp. 1-4.
7. Patel, M. D. et al. (2010), 'Distribution and fibre field similarity mapping of the human anterior commissure fibres by diffusion tensor imaging', Magnetic Resonance Materials in Physics, Biology and Medicine, vol. 23, no.5-6, pp. 399-408.