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Perceived stress moderates the effects of a randomized trial of dance movement therapy on diurnal cortisol slopes in breast cancer patients

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ABSTRACT

Women with breast cancer are at risk of psychosocial distress and may suffer from aberrant diurnal cortisol rhythms. Dance movement therapy (DMT), a movement-based psychotherapy that incorporates exercise and artistic components, has demonstrated stress reduction effects. This study examined the effects of DMT on the diurnal cortisol rhythms of breast cancer patients undergoing radiotherapy treatment and the role of perceived stress in producing such effects. The study sample comprised 121 Chinese breast cancer patients randomized to the DMT ($n = 63$) and control ($n = 58$) groups. The intervention consisted of six 1.5-h group sessions held twice weekly over the course of radiotherapy. Participants completed validated self-report measures of perceived stress, fatigue, pain, and sleep disturbance and provided five salivary cortisol samples at baseline (Time 1) and post-intervention (Time 2). Moderated mediation analysis was used to evaluate the intervention effect on Time 2 diurnal cortisol slopes. Despite the absence of a significant DMT effect on diurnal cortisol slopes (B = −0.55, 95% CI = −1.20 to 0.08, β = −0.14), baseline perceived stress significantly moderated the intervention effect (B = −0.18, 95% CI = −0.32 to −0.05, β = −0.30). At high levels of baseline perceived stress (1 SD above the mean), the DMT group showed a steeper cortisol slope (M = –7.14) than the control group (M = −5.80) at Time 2. The present findings suggest that DMT might have a beneficial effect on diurnal cortisol slopes in breast cancer patients with high levels of distress.

1. Introduction

Breast cancer is the most prevalent cancer among women worldwide (K. D. Miller et al., 2016). Radiotherapy is an integral part of treatment to reduce the risk of loco-regional recurrence in breast cancer patients (Fisher and Rabinovitch, 2014). Patients often suffer from various side effects such as fatigue, sleep disturbance, pain, and psychological distress during or after the course of radiotherapy (Sjövall et al., 2010; Noal et al., 2011; Ho et al., 2014). These comorbid symptoms are associated with not only poorer quality of life (Luutonen et al., 2014), but also disrupted activities in the hypothalamic-pituitary-adrenal (HPA) axis (Roscoe et al., 2002). HPA axis activity refers to the neuroendocrine response to stress that is reflected in the secretion of cortisol, a glucocorticoid hormone, from the adrenal gland (Gunnar and Quevedo, 2007). In normal individuals, cortisol levels follow a typical circadian rhythm, with an early morning peak upon awakening and a gradual decline throughout the day (Turner-Cobb, 2005). The diurnal cortisol slope represents the diurnal fluctuation of cortisol and is indicative of HPA axis reactivity (Smyth et al., 1997).

Schmidt et al. (2016) recently linked greater physical fatigue with increased evening cortisol levels and higher overall cortisol secretion and Tell et al. (2014) found that sleep disturbance and fatigue were associated with disrupted cortisol rhythms in breast cancer patients. Prolonged exposure to stress disturbs the regulatory feedback system of the HPA axis and leads to flatter diurnal cortisol slopes. Costanzo et al. (2012) found that cancer survivors tend to perceive everyday stressors as more severe and disruptive than do healthy controls. Breast cancer patients undergoing radiotherapy are at risk of psychosocial distress that may alter their HPA-axis activity, thus increasing the risk of neuroendocrine dysfunction and aberrant diurnal cortisol rhythms. Perceived stress and stressful daily events have been linked to flatter diurnal cortisol slopes (Lovell et al., 2011) and increased cortisol secretion (van Eck et al., 1996), respectively. These findings suggest a potential link between subjective perceived stress and disturbed diurnal

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cortisol rhythm as a physiological indicator.

Apart from the genetic and environmental factors, psychosocial factors may play a role in dysregulation of the HPA axis (Glaser and Kiecolt-Glaser, 2005). According to the bio-psycho-social model (Lutgendorf and Costanzo, 2003), the way patients respond to the environment determines their health behavior and contributes to their neuroendocrine response. Psychosocial and biological factors might have an interactive influence on health outcomes. For instance, research has linked psychological factors such as stress and depression with cancer progression (Lutgendorf et al., 2010). Circadian regulation has been advocated as a prerequisite for maintaining proper host defense against cancer (Sephton and Spiegel, 2003). The past decade has seen an increasing number of studies on the effects of non-pharmacological interventions such as qigong (Chen et al., 2013) and yoga (Chandwani et al., 2014) on the neuroendocrine system. A large randomized controlled trial by Carlson et al. (2013) showed that both mindfulness-based cancer recovery and supportive-expressive therapy resulted in more normative diurnal cortisol profiles.

Dance movement therapy (DMT) is an integrated movement-based form of psychotherapy that incorporates exercise, artistic, and recreational components (Sandel et al., 2005). The use of verbal and non-verbal approaches facilitates participants to freely express themselves through guided and self-initiated body movements (Chaiklin and Wengrower, 2009). DMT enhances participants' self-expression, acceptance, and reconnection with their bodies. The mind-body reconnection helps strengthen their personal resources, rebuild their self-confidence, and better cope with feelings of depression and fear. The group approach allows patients to share their emotions, concerns, and coping strategies with others and establish mutual social support (Ho, 2005). Previous small-sample, non-randomized studies have suggested positive results for the use of DMT in cancer patients (Dibbell-Hope, 2000; Ho, 2005; Sandel et al., 2005). A recent Cochrane review (Bradt et al., 2015) suggested that DMT had beneficial effects on the patients' quality of life, somatization, and vigor.

Our previous randomized controlled trial (Ho et al., 2016) showed that DMT provided significant benefits on symptom clusters such as perceived stress and pain in breast cancer patients. A novel examination of the physiological effects of DMT on the neuroendocrine response would provide further grounds for evidence-based research along the line of mind-body medicine. In the present study, we aimed to investigate the effectiveness of DMT on the HPA axis activity in women with breast cancer undergoing radiotherapy. To explore the potential interactions between psychological and physiological symptoms, we examined the role of perceived stress as a potential moderator and mediator of the intervention effect. The findings of this study would contribute to a better understanding of the health benefits of DMT and potential mechanisms of the intervention effects. We hypothesized that breast cancer patients would benefit from a brief DMT intervention over the course of radiotherapy by improving their HPA axis functioning.

2. Materials and methods

2.1. Study sample

The study consisted of a secondary data analysis of a randomized controlled trial of DMT to improve symptoms among women with breast cancer. The recruitment procedures, inclusion criteria, and exclusion criteria of the study participants were described in detail in a previous paper (Ho et al., 2016). The original study sample comprised 139 breast cancer patients undergoing adjuvant radiotherapy in Hong Kong, who were randomized into either the DMT group (n = 69) or the control group (n = 70). Radiotherapy for breast cancer patients was carried out in Hong Kong on an average of 30 days that last about 5 weeks. The study adopted a randomized pre-post design with participants completing self-administered questionnaires at baseline (Time 1) and at 3-week follow-up (Time 2) at the end of the treatment. Chart 1 shows the CONSORT flowchart of the present study. Nine women (three DMT and six control) withdrew from the study before the follow-up cortisol measurements due to reasons such as time pressure and other commitments. Another nine women (three DMT and six control) failed to provide at least two valid salivary cortisol measures and were excluded from the present analysis. A baseline comparison at Time 1 showed that the 18 excluded participants had similar demographic and clinical characteristics to the present sample of 121 participants. Ethical approval and written informed consent were obtained from the institutional review board and all of the study participants, respectively.

2.2. Intervention

The DMT program originated from the West and was modified to emphasize Chinese values of modesty and emotional control and suit the patients' needs, including stretching, relaxation exercises, rhythmic body movement, and improvisational dance. The intervention included six 1.5-h DMT sessions held twice a week for 3 consecutive weeks over the radiotherapy course. Each group comprised 6–10 women and all sessions were led by the first author and another qualified dance movement therapist. During the sessions, participants were encouraged to relate the movement process to their personal experiences via group dances and interactions between the group members. The intervention has been applied in local populations with good acceptance and promising effects (Ho, 2005). The control group received radiotherapy and standard nursing care in the hospitals and attended the same dance therapy treatment after completion of data collection.

2.3. Measures

2.3.1. Salivary cortisol assessment

At Times 1 and 2, saliva samples were collected using salivette tubes five times a day at the participants' home: on awakening, 45 min after waking, before lunch (12:00), in late afternoon (17:00), and before bedtime (21:00). Written instructions and verbal explanations were provided to remind the participants not to consume food, brush their teeth, or perform strenuous exercise for 30 min before the sample collection. The participants were asked to record the collection time of each sample on a time sheet with sampling instructions included. The tubes were collected from the participants within three days of sampling and kept frozen in the laboratory and cortisol levels were determined after thawing and centrifugation at 3000 rpm for 15 min using the ELIZA kit (Salimetrics, PA, USA). The intra- and inter-assay variation was less than 8%. At Time 2, screening for outliers identified 14 cortisol samples with values more than 3 standard deviations (SD) away from the mean, which were excluded from subsequent analysis. Out of the 121 participants, 93 provided valid cortisol data at all 5 assessment times, while 21, 5, and 2 participants provided valid cortisol data at 4, 3, and 2 assessment times, respectively. This resulted in a total of 568 valid values (93.9%) from the 605 collected samples. The rate of valid saliva samples was similar at Time 1.

2.3.2. Perceived stress

Perceived stress was assessed by the Chinese version of the Perceived Stress Scale (PSS) at both Times 1 and 2 (Ng, 2013). The PSS is a 10-item, 5-point instrument commonly used to assess respondents' subjective experience of stress. The total score has a theoretical range of 0–40 with higher scores indicating higher perceived stress. The Chinese version of the PSS showed good reliability ($\alpha > 0.75$) in the current sample.

2.3.3. Demographic characteristics and control variables

Information on demographic (education level, marital status, and age) and clinical (cancer stage, surgery type, cancer duration, days of radiotherapy received, and time of waking) characteristics were collected at Time 1. Participants also completed validated self-report