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EFFECTS OF BACK MASSAGE ON PSYCHOLOGICAL STATUS AND SALIVARY BIOMARKERS

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Abstract Massage therapy promotes psychosocial relaxation and reduce stress. In addition, this therapy has been reported to improve immune function. Although evaluation of psychosocial status has been performed with subjective psychological tests such as State-Trait Anxiety Inventory (STAI), subjective psychological tests are of limited value if the subjects fail to report reliably. Salivary biomarkers have been recently suggested as useful objective indicators for assessing psychosocial status. To determine whether salivary biomarkers are useful objective indices for assessing effects of back massage on psychological status in 25 young healthy female volunteers, we measured heart rate and salivary biomarkers (α-amylase, cortisol and chromogranin-A) and assessed STAI score before and after back massage. Back massage significantly reduced heart rate from 73.4±11.8 to 69.8±11.2 and STAI from 41.0±6.0 to 32.3±4.9. In contrast salivary chromogranin-A significantly increased from 2.93±2.21 to 5.29±5.46 pmol/mg protein whilst salivary α-amylase and cortisol did not change. Therefore, salivary biomarkers tested may not indicate changes in psychological relaxation following back massage. Massage therapy has been reported to not only reduce psychosocial stress but also enhance immune functions in cancer patients. In the present study, massage therapy significantly increased chromogranin-A release. As several reports clearly show that chromogranin-A has antibacterial and antifungal activities, back massage may increase host defense with salivary chromogranin-A release against oral microbial invasion.

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Key words: psychosocial relaxation; State-Trait Anxiety Inventory Score; massage therapy; salivary chromogranin-A.

Massage therapies have been reported to produce beneficial physiological effects such as vasodilation, an increase in skin temperature, body relaxation[1]. Underlying mechanisms are still unknown but hypothesized that reduction in lactic acid built-up in muscles, improving lymphatic and venous circulation and stimulation of healing of connective tissues[1]. In addition, massage also has been proposed to promote psychosocial relaxation and reduce stress[2,3].

Evaluation of psychosocial status has been performed with subjective psychological tests such as State-Trait Anxiety Inventory (STAI). However, subjective psychological test are the limitation of a self-report as the subjects may not report reliably. Therefore, alternative objective assessment methods have been sought. One of the commonest objective measures of stress involves assay of hormone levels as psychosocial stress activates the hypothalamus-pituitary-adrenocortical (HPA) axis and sympatho-adrenomedullary (SAM) system. Activation of HPA increases cortisol secretion from the adrenal cortex[4,5]. With respect to the SAM system, plasma norepinephrine is derived both from spillover of synaptic norepinephrine in the sympathetic nervous system and from the adrenal medulla. Plasma epinephrine is derived

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mainly from the adrenal medulla. Therefore, plasma cortisol and catecholamine concentrations would reflect stress status. However, blood sampling alone (with concomitant pain and stress) may also increase these stress hormone levels. Recently, measurement of salivary cortisol, α-amylase activity and chromogranin-A has been evaluated as stress biomarkers[4-8] since salivary sampling can be performed under noninvasive and non-stressful conditions.

Salivary cortisol increases with psychological stress[6,9], and correlates serum cortisol[6]. The salivary α-amylase is associated with changes in plasma norepinephrine under exercise and psychosocial stress[7]. Chromogranin-A is subject to exocytotic co-release with catecholamines from adrenal medulla and adrenergic neurons[10]. Yanaihara et al[8] found that salivary chromogranin-A is a sensitive maker of the initial psychological phase of the stress response. Therefore, these salivary biomarkers may be useful objective indicators for assessing psychosocial status.

In the present study we determined whether salivary biomarkers are useful objective indices for assessing the effects of back massage on psychological status.

We obtained the approval of our university ethics committee for this study and the informed consent of the volunteers. The participants in this study were 25 young healthy female students of Department of Nursing, Hirosaki University School of Health Sciences (age from 21 to 23 y, 21.8±0.6 y). Questionnaires prior to the experiment confirmed absence of physical or mental illness, any medication affecting autonomic nervous and endocrine systems and severe periodontal disease causing a tendency to gingival bleeding. The subjects were instructed to abstain from eating and drinking any beverages except water and brushing teeth 1 h and 3 h before the experiment, respectively.

Experiments were performed between 13:00 and 18:00 to minimize any circadian rhythm effects. After the volunteers had rinsed their mouth with water and an electrocardiogram was attached, they rested in a chair for 10 min. Volunteers then received the same standardized massage of the back for 10 min with non-aromatic oil.

We used the state section of STAI in Japanese translation (STAI-s) to assess the responsibility to anxiety. STAI consists of two separate, self-report scales for measuring the distinct concept of state and trait anxiety. STAI-s can measure the temporary and situational anxiety state accompanied by autonomic excitement.

Saliva sampling, measurement of STAI-s and heart rate were carried out before the massage, immediately after and 30 min after the massage.

Saliva was collected with a cotton swab and placed in special sampling tubes (Salivettes, Sarstedt, Nümbrecht, Germany). The tubes were then centrifuged for 3 min at 1500g to obtain clear saliva, which was stored at -80 ℃ until assayed. Salivary chromogranin-A and cortisol were assayed using an enzyme immunoassay kit according to the manufacturers instructions (YKO70 Human Chromogranin-A, EIA kit, Yanaihara Institute, Shizuoka, Japan and Salivary Cortisol EIA kit, Salimeterics Inc, PA, USA, respectively). Salivary α-amylase activity was assayed using a commercial kit according to the manufacturer's instructions (Salivary α-amylase Assay Kit, Salimeterics Inc, PA, USA). Chromogranin-A levels were corrected by salivary protein, which was determined using the Bio-Rad Protein assay kit, and expressed as pmol/mg protein. Intra-assay maximal coefficient of variation was 8.15% for chromogranin-A, 6.22% for cortisol and 6.70% for α-amylase. Inter-assay maximal coefficient of variation was 12.42% for chromogranin-A, 6.88% for cortisol and 5.8% for α-amylase.

Data are presented as mean±SD. Statistical analysis was performed using one-way repeated

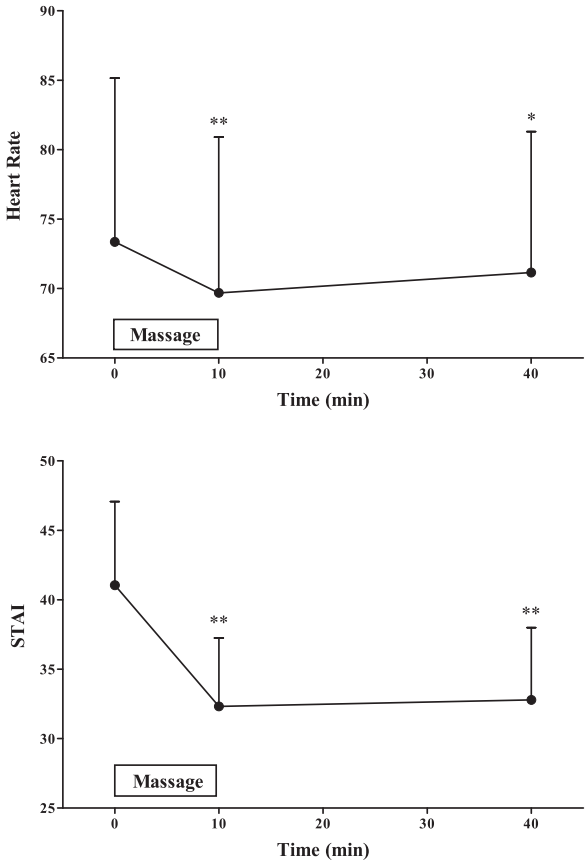

Figure 1 Effects of back massage on heart rate (A) and STAI-s score (B). Mean±SD, 0 min: before massage, 10 min: just after massage finished, 40 min: 30 min after completion of massage, *: $p<0.05$, **: $p<0.01$ vs 0.

Table 1. Effects of back massage on salivary chromogranin-A levels, α-amylase activity and cortisol levels.

Salivary biomarkers	Time (min)		
	0	10	40
Chromgranin-A (pmol/mg protein)	2.93 ± 2.21	5.29 ± 5.46*	4.46 ± 5.11
α-Amylase activity (U/ml)	60.5 ± 39.8	54.5 ± 38.7	73.5 ± 57.6
Cortisol (μg/dl)	0.173 ± 0.149	0.195 ± 0.227	0.167 ± 0.168

Mean ± SD, 0 min: before massage, 10 min: just after massage finished, 40 min: 30 min after completion of massage, *: $p<0.05$ vs 0.

measures analysis of variance followed by Student-Newman-Keuls test using Sigma Sat for Windows (Jandel Scientific Software, Chicago IL). A $p<0.05$ was considered significant.

Back massage significantly reduced heart rate and STAI-s score (Figure 1). In contrast salivary chromogranin-A increased significantly just after completion, while salivary α-amylase and cortisol levels did not change (Table 1).

In the present study, salivary biomarkers such as α-amylase activity, cortisol and chromogranin A did not decrease, despite reductions in STAI-s and heart rate after the back massage, which indicated psychosocial relaxation. Therefore salivary biomarkers tested may not reflect changes in psychological status

due to back massage. These salivary biomarkers have been reported to reflect psychological stress. Nakane et al[4] reported that salivary chromogranin-A significantly increased with a word processing task. Tateoka et al[11] also found a good relationship between labor-induced stress and salivary chromogranin-A. Chatterton et al[7] reported that the salivary α-amylase activity is associated with changes of plasma norepinephrine concentration under exercise and psychosocial stress. Rohleder et al[12] also showed a positive association between increases of α-amylase activity and plasma norepinephrine induced by psychosocial stress with the Trier Social Stress Test. In addition, many studies[13-15] have suggested that salivary cortisol significantly increase by psychological stressors. Therefore, these salivary biomarkers may be good indicators for assessing psychological stress but not for psychological relaxation.

Massage therapy has been reported to not only reduce psychosocial stress but also enhance immune functions in cancer patients[2,16]. Moreover, massage therapy has also been shown to improve immune function in HIV children and adolescent patients[17,18]. In the present study, massage therapy significantly increased chromogranin-A release. As several reports[19,20] clearly show that chromogranin-A has antibacterial and antifungal activities. Vasostantin-1, which is naturally processed from the N-terminal 1-76 of chromogranin-A, inhibits the growth of bacteria and fungi[19,20]. Therefore, as a result of back massage elevated chromogranin-A release may increase host defense against oral microbial invasion. Similarly, although salivary immunoglobulin A has also been suggested to be a good indicator for assessing psychological stress[21,22], Groer and colleagues[23] reported that a 10-minute nursing back rub increased salivary immunoglobulin A secretion despite an decrease in STAI score. Salivary immunoglobulin A also acts as a first line of host defense against microbial invasion[24]. Therefore, massage therapy may reinforce host defense with an increase in secretion of antimicrobial peptides such as chromogranin A and immunoglobulin A.

In conclusion, the present data suggests that salivary biomarkers tested may not indicate changes in psychological relaxation following back massage. Back massage may increase host defense with salivary chromogranin-A release against oral microbial invasion.

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