

Effects of Foot-Massage on Mood and Autonomic Nervous System and the Interaction with Personality

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Abstract

Massage is often used to reduce psychological distress or to improve local circulation, but, the effects of massage are neither stable nor consistent. The purpose of this study was to evaluate effects of foot-massage on mood and autonomic nervous system in highly stressed students, and the interaction with personality. We selected highly stressed students by scores of daily hassles scale and profile of mood states (POMS). We employed POMS and visual analogue scale to assess mood, and employed heart rate variability, systolic and diastolic blood pressure (BP), and baroreflex sensitivity to assess autonomic nervous function. Repeated measures analysis of variance (ANOVA) revealed increase of vigor and comfortableness, and decrease of diastolic BP after foot-massage. To evaluate the interaction with personality, repeated measures ANOVA was applied to two groups (low- and high-) divided by the score of clinical scale of Minnesota Multiphasic Personality Inventory (MMPI). High-Pa group (considered to be sensitive in human relationships) showed significant decrease of tension-anxiety after the massage, but low-Pa did not. Low-Si group (considered to be socially active) showed significant decrease of anger-hostility and fatigue after the massage, but high-Si did not. And low-Ma group (considered to be temperate and adjusting slowly) showed remarkable decrease of diastolic BP after the massage, but high-Ma did not. These results suggest that foot-massage would generally raise vigor and comfortableness, and decrease diastolic BP, however, the effects would be different from person to person, and beneficial effects to reduce tension-anxiety, anger-hostility and fatigue can be expected dependent on their personality.

Keywords Massage; Profile of mood states; Heart rate variability; Minnesota Multiphasic Personality Inventory

Abbreviations:

POMS = profile of mood states, HRV = heart rate variability, BP = blood pressure, ANOVA = analysis of variance, MMPI = Minnesota Multiphasic Personality Inventory, VAS = visual analogue scale, HF = high-frequency, LF = low-frequency, ECG = electrocardiogram

Introduction

Massage is known to reduce anxiety or pain and to improve local circulation [1-5]. Massage can easily be provided anywhere without any specific apparatus. Therefore, massage is frequently used as a complementary and an alternative therapy everywhere in various occasions. Recently, there are growing number of stressors in the surrounding environment of schoolchildren which can induce psychosomatic disorders or behavioral problems, and stress coping strategy is a great issue of an educational site. Massage can be used as one of stress coping tools at schools, however, effects or application criteria of massage is not determined precisely.

Profile of mood states (POMS) is designed to measure a person's affective states, with scores of six subscales, and is thought to be a useful tool for estimating moods repeatedly and has been a popular research tool among psychologists [6]. A visual analogue scale (VAS) is also an effective tool to assess subjective momentary feeling, which varies continuously and cannot easily be directly measured [7-9].

Numerous studies have indicated that a spectral analysis of heart rate variability (HRV) is a powerful tool for evaluating autonomic nervous functions non-invasively [10-16]. Baroreflex sensitivity as well as blood pressure is also considered to be related with autonomic nervous function or mental state and is known to decrease under stressed condition [17,18].

Minnesota Multiphasic Personality Inventory (MMPI) is designed to provide an objective assessment of some of the major personality characteristics that affect personal and social adjustment [19,20]. Since massage is a kind of social contact, we thought there might be some correlations between effects of foot-massage and personality factors assessed by MMPI.

Then, we studied effects of foot-massage on mood and autonomic nervous system in highly stressed students using POMS, and VAS for mood estimation, and HRV, systolic and diastolic blood pressure (BP), and baroreflex sensitivity for an evaluation of autonomic nervous system. Each person has an own personal space which would vary dependent on a situation and a person in contact, as well as on his/her personality characteristic. There could be some individual differences in the response pattern to foot-massage, which would be obscured by analyzing the data from individuals with different personalities together. Therefore, we classified the subjects according to their personality assessed by MMPI, and analyzed the autonomic and mood data before and after the massage in relation to subject's personality as well as the condition (massage or control).

Numerous studies have demonstrated that autonomic nervous function is modulated by various factors such as a physical stimulus [21,22], and a mental load [13,14]. To minimize direct physical effects

of touch, pressure sensation, or pain caused by the massage, we excluded physiological data during foot-massage from the analysis, and analyzed the data before and after foot-massage.

Thirty minutes data after the massage were divided into 6 five-minute blocks and analyzed. Consequently, the analyzing procedure would allow us to identify immediate, and late effects induced by foot-massage avoiding the contamination of direct physical effects induced by the massage.

Methods

Measures

Daily hassles scale: Daily hassles scale was designed to measure stressors in daily life by Lazarus et al. as an alternative to stressful life event inventories and translated into Japanese by Munakata et al. [23-26]. The hassles scale include 30 items, such as about their family's future, about their health, or about relationship with the opposite sex, which can be irritating, frustrating demands that occur during everyday transactions with the environment, and subjects select the extent to which they feel irritation or frustration for each item. Stress level was evaluated by the number of items for which they feel irritation or frustration.

Profile of mood states (POMS): Comprehensive mood was assessed by the POMS which was designed to measure a person's mood states, and include six subscales: Tension-anxiety; T-A, Depression-dejection; D, Anger-hostility; A-H, Vigor; V, Fatigue; F, and Confusion; C. Subjects are given a score for each trait according to their responses to certain statements which include key words such as unhappy, tense, careless, and cheerful. For each statement, subjects state how they feel at that moment, or how they felt over the previous day, few days, or week, by choosing one of the following responses: not at all; a little; moderately; quite a lot; extremely. Score for each scale was converted into T-score for parametric statistical analysis [6].

Visual analogue scale (VAS): Subjective momentary feelings were evaluated by the VAS which was a horizontal line, 100 mm in length, anchored by word descriptions at each end, and a participant marks on the line the point that they feel represents their current feeling state [7-9]. Each score was determined by measuring the distance from the left end to the point they marked. The VAS was applied for the assessment of 5 feelings; tense or relaxed, uncomfortable or comfortable, anxious or relieved, tired or vigorous, and depressed or fine. Higher ratings on each scale indicated more relaxed, more comfortable, more relieved, more vigorous, and finer.

Minnesota multiphasic personality inventory (MMPI): Personality characteristic was assessed by the MMPI which was designed to provide an objective assessment of some of the major personality characteristics that affect personal and social adjustment [19,20]. It was primarily intended to test people who are suspected of having mental health or other clinical issues, and came to be widely used in mental health field or in related areas to assess personality trait, regardless of clinical issues. The MMPI consists of 550 true/false questions, and subjects are requested to select an answer to the questions "yes (true)", "no (false)", or "cannot say", minimizing the number of "cannot say" [19,20]. Subjects are given a score for each ten clinical scale (Hs; hypochondriasis, D; depression, Hy; hysteria, Pd; psychopathic deviate, Mf; masculinity-femininity, Pa; paranoia, Pt; psychasthenia, Sc; schizophrenia, Ma; hypomania, Si; social introversion) according to their true/false answers to the questions.

Heart rate variability (HRV): Heart rate varies according to respiration and blood pressure variation, and the extent of variation of heart rate is usually dependent the autonomic nervous activity. HRV can be divided into two main components by spectral analysis, i.e., a high-frequency component (HF) which corresponds to respiratory sinus arrhythmia and reflects parasympathetic nerve activity, and a low-frequency component (LF) which corresponds to Mayer wave related sinus arrhythmia and relates to both sympathetic and parasympathetic nerve activities [10-12,15,16]. Therefore, we can know the level of autonomic nervous activity to some extent by the spectral analysis of HRV.

Baroreflex sensitivity: When baroreceptor detect a decrease of intravascular pressure, autonomic nervous system attempt to compensate the decrease by constriction of peripheral vessels and enhancement of cardiac contraction force along with an increase of heart rate. Therefore, ratio of heart rate variation to blood pressure variation is considered to indicate baroreflex sensitivity, and the sensitivity is calculated as the ratio of LF amplitude of HRV to LF amplitude of systolic BP variability. Baroreflex sensitivity is known to decrease in persons with hypertension or under stressed condition [17,18].

Blood pressure (BP): Blood pressure is determined by cardiac output \times total peripheral resistance, which are mainly regulated by endocrine system and autonomic nervous system. Short-term control of BP is mainly achieved by sympathetic and parasympathetic activity which will affect diameters of veins and arteries to change blood distribution in the body, and heart to control heart rate and force of contraction. Then, systolic and diastolic BP may be influenced by local circulation change, possibly induced by vasoconstriction or vasodilatation, along with the change of autonomic nervous activity.

Participants

We applied daily hassles scale and POMS questionnaires to 244 female college students, and selected the students who scored more than 15 points in daily hassles and more than 54 points in negative mood score (average of T-scores of 5 negative scales in POMS; T-A, D, A-H, F, C) of POMS as potential candidates, since the mean value for 244 students of daily hassles and negative mood score were 15.06 and 54.78, respectively. Consequently, 31 students out of those who met the above criteria for the candidate, agreed and participated in this experiment after providing written informed consent. The age of the participants ranged from 18 to 22. They were asked to abstain from eating, drinking and smoking for at least three hours before the experiment, and to sleep for 6 hours or more on the previous day. Strenuous exercise and heavy drink on the previous day were also prohibited.

Procedures

Each participant was randomly assigned to massage group (n=19) or control one (n=12). The day and time of the two experiments (massage and control) was counterbalanced since mood and autonomic nervous activity could change depending on the day of the week and the time zone [27]. The experiments were carried out in their follicular phase after the third day of the menses, to minimize the influences of a menstrual cycle which could affect mood and autonomic nervous activity. The experimental room and the around was kept quiet and the room temperature was kept at 22 ± 2 degree Celsius. Each experiment consisted of five parts: a pre POMS and VAS

period of several minutes; basal recording of 10 minutes; foot-massage period (or rest period for control condition) of 10 minutes; post-massage period of 30 minutes which were divided into six 5-minute blocks for later analysis, and a post POMS and VAS period of 5 minutes.

Having previously completed MMPI questionnaires to evaluate their personality characteristics, the subjects entered the room and were asked to fill out POMS questionnaires and VAS to ascertain their current mood for an evaluation of their basal mood state. Each subject sat upright on a reclining chair (inclined at an angle of around 45 degree) while disc electrodes were attached for chest electrocardiograms (ECG) with CM5 leads and a thermistor for detecting respiration was also attached just under one nostril. Blood pressure was also measured with tonometric method (Colin Japan). Foot bathing was performed by soaking their feet into warm water (38 degree Celsius) for a minute and wipe their feet with a towel to clean the feet before foot-massage was applied. Foot-massage was originally constructed to be easily performed and to be comfortable to the participants, and provided for 10 minutes by a single female practitioner to minimize the difference of massage quality dependent on the skill. The massage consisted of rubbing with light squeezing from ankle to toe, kneading and pressing fingers, moving the flats of the hands around ankle bones, pinching an Achilles' tendon, and rubbing and pressing the sole of the foot. A subject in control condition was given foot bathing and kept still without the massage for 10 minutes. ECG, BP and respiration curves were recorded throughout the experiment. Data were stored on a personal computer equipped with a 12-bit analog-digital converter (ADTM-98, Canopus, Kobe, Japan) for subsequent offline analysis.

Subjects were asked to keep quiet, avoiding any disruptive movements of their heads or hands throughout the experiments. They were also asked to keep their eyes closed but not to fall asleep during the pre-massage period, the massage period, and the post-massage period. After the post-massage period of 30 minutes, they were asked to fill out POMS questionnaires and VAS describing their mood for an evaluation of whatever mood states were induced by the massage or rest (control condition).

This study was approved by the Ethics Committee of Aichi University of Education and was performed according to the Declaration of Helsinki.

Data Analysis

MMPI data were manually scored with hand-scoring stencils and summed for ten clinical scales: Hs, D, Hy, Pd, Mf, Pa, Pt, Sc, Ma and Si [19]. These raw scores were converted into T-scores according to a new Japanese version of the MMPI manual [20] for parametric statistical analysis. Subjects were divided into low and high groups by median split method according to their T-score of each clinical scale. POMS data were summed to generate six sub-scales: T-A, D, A-H, V, F and C. These summed raw scores were converted into T-scores for parametric statistical analysis according to the POMS manual [6]. Negative mood score was also calculated by averaging T-scores of 5 negative scales (T-A, D, A-H, F and C).

ECG data were digitized at a sampling frequency of 1 kHz on a personal computer. After detecting every R-wave peak, consecutive R-R intervals on the ECG were calculated, excluding ectopic beats and abrupt discharges in R-R intervals. Spectral analysis was applied to the time series data of R-R intervals for each 5 min, using the maximum-

entropy method (MemCalc Version 2.5, Suwa Trust) [28]. After calculating the power-spectral density, the magnitude of the power for HRV was obtained by measuring areas under the spectral density curves. The values were divided into two major bands, a low-frequency component (LF; 0.04-0.15 Hz) and a high-frequency component (HF; 0.15-0.4 Hz). Thereafter, the amplitude of each frequency band was calculated as twice the power magnitude and the square root thereof. We considered HF amplitude (HF) as an index of parasympathetic nervous function and LF/HF amplitude (LF/HF) as a marker of relative sympathetic activity [12,27].

BP wave forms were also digitized at a sampling frequency of 1 kHz on a personal computer. Beat-to-beat systolic and diastolic peaks of the BP wave were detected and stored as time series data of systolic BP and diastolic BP, respectively. Spectral analysis was applied to the time series data of systolic BP for each 5 min, then LF and HF amplitudes of systolic BP variability were obtained in the same way as the spectral analysis of HRV. Thereafter, baroreflex sensitivity was calculated as the ratio of LF amplitude of HRV to LF amplitude of systolic BP variability. Mean systolic BP and diastolic BP were also calculated for every 5 min.

Five-minute data just prior to the massage period were averaged and used to establish pre-massage basal activity (basal). Thirty-minute data for the post-massage period were grouped into 6 five-minute blocks, averaged, and represented as post 1, 2, 3, 4, 5 and 6.

Statistical Analysis

To clarify the effects of foot-massage on mood and autonomic nervous function, interactions between condition (massage and control: between-subjects variable) and time course (before and after the massage: within-subjects variable) were examined by repeated measures analysis of variance (repeated measures ANOVA). A repeated measures ANOVA is referred to as a within-subjects ANOVA and is suitable to investigate changes in values over time from the same participants, and can examine the difference of trend of values among groups. Furthermore, to clarify the influence of personality trait on effects of foot-massage, repeated measures ANOVA were performed on 3 steps as follows: 1st step; condition (massage and control: between-subjects variable) \times group (high and low group of each 10 clinical scale: between-subjects variable) \times time course of all outcome parameters (pre to post, or pre through post 1 to post 6: within-subjects variable) interaction were calculated and significant interactions were selected. 2nd step; data set were divided into massage and control condition, and group (high or low group of clinical scale which showed significant interaction on 1st step) \times time course of outcome parameter (which showed significant interaction on 1st step) interaction were calculated in both conditions, and significant interactions in massage condition were selected. 3rd step; data set were divided into high and low group of clinical scale which showed significant interaction on 2nd step, and condition (massage and control) \times time course of outcome parameters (which showed significant interaction on 2nd step) interaction were calculated in both groups, and significant condition \times time course interaction in either group was considered to indicate significant influence of personality trait on effects of foot-massage, and presented in Figure 4 and 5. All the subjects were divided into two groups by a median of T-score of each MMPI clinical scale (median split method). That is, those with a score of median or higher were assigned to the high group, and the others to the low group, as follows: high Hs; n=17, low Hs; n=14, high D; n=19, low D; n=12, high Hy; n=16, low Hy; n=15, high Pd; n=17,

low Pd; n=14, high Mf; n=19, low Mf; n=12, high Pa; n=16, low Pa; n=15, high Pt; n=18, low Pt; n=13, high Sc; n=16, low Sc; n=15, high Ma; n=16, low Ma; n=15, high Si; n=16, low Si; n=15. Furthermore, paired t-test was carried out to know whether the scores changed significantly from pre to post, when repeated measures ANOVA revealed significant interaction. Statistical analysis was performed on a personal computer using Statview Ver. 5.0 (HULINKS), and differences with a probability value of less than 0.05 were considered significant.

Results

Effects of massage on mood

Figure 1 shows T-scores of 6 subscales of POMS before and after massage period. Repeated measures ANOVA revealed significant interaction of condition (massage or control) × change (from pre- to post-massage period) in V subscale ($F(1,29)=6.225, p=0.0185$), that is, Vigor increased significantly under massage condition, but not under control.

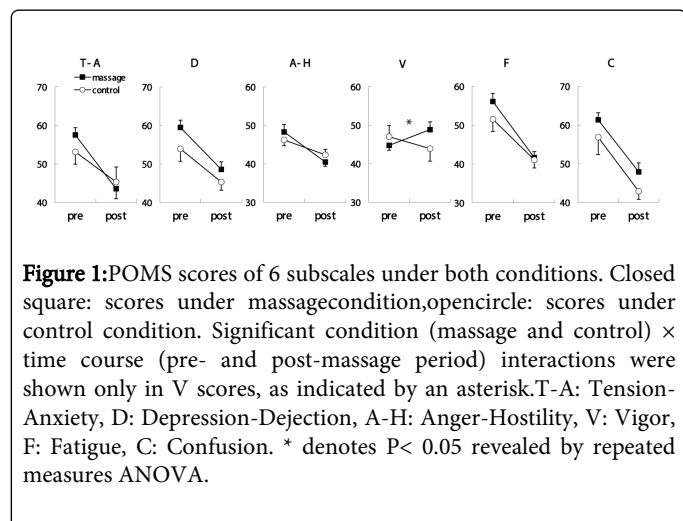


Figure 1: POMS scores of 6 subscales under both conditions. Closed square: scores under massage condition, open circle: scores under control condition. Significant condition (massage and control) × time course (pre- and post-massage period) interactions were shown only in V scores, as indicated by an asterisk. T-A: Tension-Anxiety, D: Depression-Dejection, A-H: Anger-Hostility, V: Vigor, F: Fatigue, C: Confusion. * denotes $P < 0.05$ revealed by repeated measures ANOVA.

Paired t-test revealed significant increase in V score under massage condition ($p=0.0255$), but not under control condition ($p=0.2360$). The other subscales (T-A, D, A-H, F, C) decreased under both conditions and the extents were fairly similar.

Figure 2 shows 5 components of VAS before and after massage period. Repeated measures ANOVA revealed significant interaction of condition (massage or control) × change (from pre- to post-massage period) in uncomfortable or comfortable scale ($F(1,29)=9.163, p=0.0051$), and tired or vigorous scale ($F(1,29)=4.698, p=0.0385$), in VAS, that is, subjects in massage group became more comfortable and vigorous after the massage period than those in control group. Paired t-test revealed significant increase in Comfortable score ($p=0.0000$) and Vigorous score ($p=0.0000$) under massage condition, and non-significant increase in Comfortable score ($p=0.2587$) and significant increase in Vigorous score ($p=0.0287$) under control condition. The other scales (tense or relaxed, anxious or relieved, and depressed or fine) improved in both groups and the extents were almost similar.

Effects of massage on autonomic activity

Figure 3 shows trends of autonomic indices throughout the experiments. Repeated measures ANOVA revealed significant interaction of condition (massage or control) × trend (from pre- to post-massage period) in diastolic BP ($F(6,174)=3.457, p=0.0030$), that is, diastolic BP decreased gradually 15 minutes after the massage period or later in massage group, while did not in control group. The trends of the other autonomic indices (HF amplitude, LF/HF amplitude, systolic BP, and baroreflex sensitivity) were not significantly different among both groups.

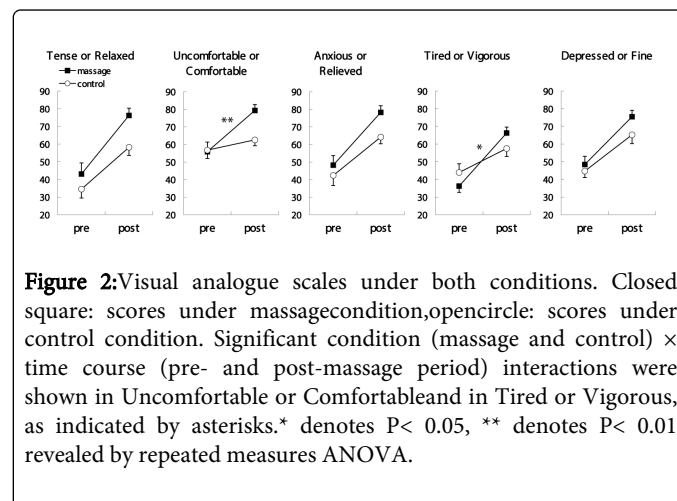


Figure 2: Visual analogue scales under both conditions. Closed square: scores under massage condition, open circle: scores under control condition. Significant condition (massage and control) × time course (pre- and post-massage period) interactions were shown in Uncomfortable or Comfortable and in Tired or Vigorous, as indicated by asterisks. * denotes $P < 0.05$, ** denotes $P < 0.01$ revealed by repeated measures ANOVA.

Interactive effects of massage and personality

To elucidate whether effects of foot-massage were significantly different dependent on their personality, repeated measures ANOVA were separately applied to the high and low groups of clinical scales of MMPI, according to the 3 steps mentioned above in the method section. Figure 4 shows T-A, A-H, F changes in each group. Low Pa group showed slight decrease of T-A in both conditions, while high Pa showed more decrease of T-A in massage condition than control condition ($F(1,14)=11.286, p=0.0047$). Paired t-test revealed significant decrease of T-A score in high Pa group under massage condition ($p=0.0000$), but not under control condition ($p=0.2802$). Low Si group showed more decrease of A-H in massage condition than control condition ($F(1,13)=6.361, p=0.0255$), while high Si showed slight decrease of A-H in both conditions. Paired t-test revealed significant decrease of A-H in low Si group under massage condition ($p=0.0023$), but not under control condition ($p=0.2114$). Low Si group showed more decrease of F in massage condition than control condition ($F(1,13)=10.032, p=0.0074$), while high Si showed slight decrease of F in both conditions. Paired t-test revealed significant decrease of F score in low Si group under massage condition ($p=0.0001$ for F), but not under control condition ($P=0.0957$). Figure 5 shows trends of diastolic BP in low and high Ma groups. Low Ma group showed gradual decrease of diastolic BP 15 minutes after the end of the massage and later in massage condition ($F(6,78)=4.823, p=0.0003$), while high Ma showed similar trends of diastolic BP in both conditions.

Discussion

T-A, D, A-H, F, and C subscales in POMS decreased, and scales of tense or relaxed, anxious or relieved, and depressed or fine in VAS

improved through the experiments in both conditions. That is, subjects generally became more relaxed, relieved and fine whether they received massage or not. Rest itself would possibly have beneficial effects on their moods. While V subscale in POMS and tired or vigorous scale in VAS increased more in massage condition than control condition. This would indicate that the massage is effective to recover from fatigue and to restore vitality. Uncomfortable or comfortable scale in VAS improved more in massage condition than control condition. The reason why subjects became more comfortable after the massage is unknown, however, the fact that someone was performing foot-massage for them might have some contribution to making them feel better.

Trends of diastolic BP were significantly different between massage condition and control, while those of the other autonomic indices (HF amplitude, LF/HF amplitude, and systolic BP) were not significantly different between both conditions. Massage is reported to increase peripheral blood flow in young women [5]. Local circulation improvement possibly induced by the massage may have some correlation to the decrease of diastolic BP in massage condition. Moyle et al. also described decreases in diastolic BP, along with a reduction of anxiety, immediately after a 10-min foot massage [29].

Foot-massage may be effective in reduction of tension and anxiety for subjects in high Pa group, since T-A score significantly decreased after the massage in this group. Previous studies describe reduction of anxiety after massage regardless of the recipients' personality [4,29,30]. Females who get high score in Pa scale are considered to be emotional, sensitive and high-strung [19]. The massage might improve human relationship by touching and reduce tension and anxiety. Or the interaction between massage and personality may be attributable to mood self-adjustment rather than physical stimulus caused by the massage, since it has been suggested that meditation is also associated with personality changes [31]. On the other hand, females who get low score in Pa scale are considered to be conventional, serious, and self-controllable which may confound the effects of foot-massage [19]. Foot-massage may be effective in reduction of anger, hostility and fatigue for subjects in low Si group, since this group showed more decrease in A-H and F score than high Si group after the massage. Females who get low score in Si scale are considered to be socially active and like to contact with others [19]. These tendencies may have some relation to the beneficial effects of foot-massage. On the contrary, females who get high score in Si scale are considered to be modest, shy and not like to contact with others, which may counteract the effects of foot-massage [19].

HRV indices did not show any significant interactions, while trend of diastolic BP showed significant condition (massage or control) × MMPI group interaction. Low Ma group showed significant reduction in diastolic BP 15 minutes after the massage period and thereafter, under massage condition, though there was not supposed to be any systemic autonomic function change. Local circulation might have had remarkably improved in low Ma group, which consequently lowered diastolic BP after the massage. Females who get high score in Ma scale are considered to be frank, energetic and talkative, while females who get low score in Ma are considered to be temperate, adjusting slowly, and reasonable [19]. The exact reason why diastolic BP decreased after the massage in low Ma and not in high Ma is unknown, however, there may be some link between this personality and local circulation control system, or energetic tendency in high Ma may facilitate sympathetic nervous function and counteract the effects of the massage.

There are some limitations to consider in this study. Our sample size was small, and the massage duration of 10 minutes was short. Repeated and longer duration massage with larger sample size may have more consistent and clear effects. We also cannot exclude the placebo effects since subjects could clearly know whether they were receiving foot-massage or only wiping.

We selected highly stressed persons beforehand by POMS and daily hassles scale, but there may be some persons who relieved to some extent on the experiment day since improved mood was expected in some persons from their POMS scores just before the experiment. We employed not schoolchildren but female college students as subjects in this study. Then, there may be some differences by age or gender, and may not be generalized to students in wide age range.

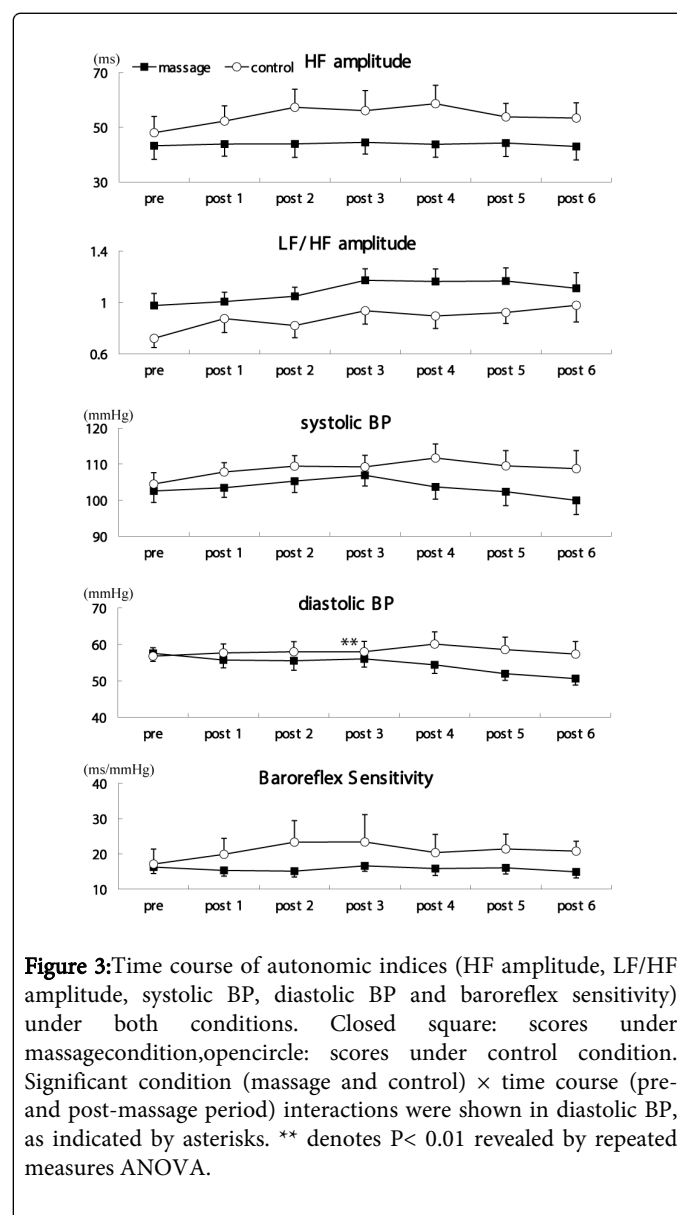


Figure 3: Time course of autonomic indices (HF amplitude, LF/HF amplitude, systolic BP, diastolic BP and baroreflex sensitivity) under both conditions. Closed square: scores under massage condition, open circle: scores under control condition. Significant condition (massage and control) × time course (pre- and post-massage period) interactions were shown in diastolic BP, as indicated by asterisks. ** denotes $P < 0.01$ revealed by repeated measures ANOVA.

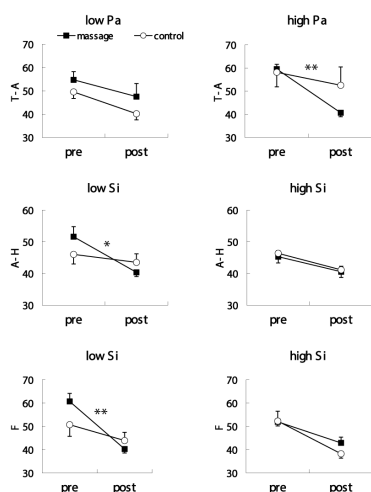


Figure 4: T-A of POMS under both conditions in high-Pa and low-Pa group, and A-H and F of POMS under both conditions in high-Si and low-Si group. Closed square: scores under massage condition, open circle: scores under control condition. Significant condition \times time course (of T-A) interaction is shown in high Pa as indicated by asterisks, but not in low Pa. Significant condition \times time course (of A-H, and F) interactions are shown in low Si as indicated by an asterisk, and asterisks, respectively, but not in high Si. * denotes $P < 0.05$, ** denotes $P < 0.01$ revealed by repeated measures ANOVA.

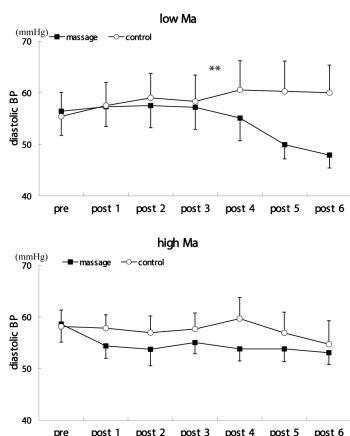


Figure 5: Diastolic BP, under both conditions in high-Ma and low-Ma group. Closed square: values under massage condition, open circle: values under control condition. Repeated measures ANOVA showed significant condition \times time course (of diastolic BP) in low Ma as indicated by asterisks, but not in high Ma. ** denotes $P < 0.01$ revealed by repeated measures ANOVA.

Conflict of Interests

The author declares that there is no conflict of interests regarding the publication of this paper.

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