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Effects of “Foot Bathing” on Psycho-Somatic Responses in Healthy Young Adults

Akiyo Morishita¹, Yasuo Nakata¹, Yumi Tamura², Yuichi Ishikawa², Peter Bontje³, Hitomi Takase⁴, Yurina Kubo⁵, and Noriko Tsuda²

“Foot Bathing” has been recognized as an effective nursing care intervention, however its effects are not fully understood yet. The purpose of this study was to examine immediate psychological and physiological effects of “Foot Bathing”. Thirteen healthy adults, 6 men and 7 women (22.3±0.4 years old), participated in this study. Psychological effects were assessed by using the State-Trait Anxiety Inventory (STAI) and the Profile of Mood States (POMS) just before and after “Foot Bathing”. Physiological parameters studied were heart rate (HR), blood pressure (BP), and “Wavelet Transforms” of Heart Rate Variability (HRV). “Wavelet Transforms” of HRV were analyzed by using computer software “Fluclet”, a hemodynamic and autonomic nervous activity analysis system. The mean values of high frequency component (HFC) and low frequency component (LFC) of HRV, LFC–HFC ratio for 10 seconds before and after “Foot Bathing” were calculated. Just before and after “Foot Bathing” HR, BP, state anxiety score of STAI, and 6 scales of POMS were measured. Significant improvements in psychological states were found for the state anxiety factor of STAI and the following 5 scales of POMS, “Tension-Anxiety” “Depression-Dejection” “Anger-Hostility” “Fatigue” “Confusion”. Physiological states had no significant differences. These findings demonstrate that “Foot Bathing” gives subjects a beneficial psychological effect, however these were not reflected to the measured physiological responses. Further study is needed to identify physiological effects that reflect changes in psychological states and to demonstrate the time lag between the interventions and physiological responses.

**Key Words**
Foot Bathing, Wavelet Transforms, Heart Rate Variability, STAI, POMS.

**Introduction**

“Foot Bathing” has been performed to maintain skin integrity of the foot since long time ago. “Foot Bathing” has also become popular in the complementary/alternative therapy and relaxation fields in recent years. “Foot Bathing” does not only maintain skin integrity and foot function, but is also comfortable and relaxing to patients. In Japan there have been about three hundred researches were reported in the database of the Igaku Chuo Zassi (Japana Centra Revuo Medicina) during the last twenty years. A review of the Igaku Chuo Zassi reveals
that the effects of “Foot Bathing” were typically measured only by physiological parameters in the '80s, but both physiological and psychological measurements were used from the '90s up to the present. In foreign countries there seems a little research on the effects of “Foot Bathing” itself. “Foot Bathing” in foreign countries has been incorporated into complementary/alternative therapy, especially aromatherapy, rather than performed as nursing practice. Researches in foreign countries have considered physiological or psychological parameters separately, but did not attempt to demonstrate their relationship. In foreign countries, physiological parameters traditionally used for investigations were Heart Rate (HR), Blood Pressure (BP) and respiratory rate, and a few researches of “Foot Bathing” in aromatherapy used power spectral analysis of heart rate variability (HRV).

Power spectral analysis of HRV has become a popular tool that can estimate one’s autonomic nervous activities. High frequency component (HFC), low frequency component (LFC), and LFC/HFC ratio calculated from power spectrum of HRV are useful indices of autonomic nervous system function.

The purpose of this study was to examine the immediate psychological and physiological responses of “Foot Bathing”, and to compare these psychological responses and immediate physiological responses. It is hoped that through identifying relevant physiological parameters that can be measured in clinical situations we will be better able to understand subject’s psychological states.

Method

Participants

Thirteen healthy adults, six men and seven women (22.3±0.4 years old) participated in this study. Participants were informed verbally and in writing about the purpose of this study and gave their consents to participate in this study. All personal data were transformed to code to prevent identification of the individuals.

Procedure

The investigation was conducted in an air-conditioned room between October 22 to November 16 in 2001, where temperature was maintained between 22 and 25 °C and humidity was kept between 50 and 60 percent.

Participants were rested on a bed for 5 minutes after completing the psychological questionnaires and put on a Holter electrocardiograph. After that, participants soaked their foot in 39°C water. The participants maintain a supine position with drawn up knees and their feet in the water basin placed on the bed. After about 1 minute of soaking their foot, participants had their feet washed with soap by a sponge, each foot for 5 minutes. Next, participants were given a foot massage in a changed bath, again each foot for 5 minutes. One person performed the total process of “Foot Bathing” for all participants. Participants completed the same psychological questionnaires again after 5 minutes bed rest (Figure 1). Experimental procedure was performed at 11:00 to 18:00, as a matter of subject’s convenience, 0.5 to 5 hours after eating. Circadian rhythm was not considered in this study.
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Parameters

Psychological states
To estimate psychological states, we used State–Trait Anxiety Inventory (STAI) and Profile of Mood States (POMS). State–Trait Anxiety Inventory and POMS were used before and after "Foot Bathing". State–Trait Anxiety Inventory is a self–report style questionnaire that by Spielberger. It can quantify one’s trait and state of anxiety. The Japanese version of STAI developed by Nakazato & Mizuguchi, has been used in various fields. Profile of Mood States is a self–report style questionnaire developed by McNair. It can assess 6 types of one’s mood, “Tension–Anxiety” “Depression–Depression” “Anger–Hostility” “Fatigue” “Confusion” and “Vigor”. It was adapted for use with Japanese people and has been used in various fields.

Physiological states
To analyze physiological states, we measured HRV (HFC, LFC, LFC/HFC), HR, and BP. Electrocardiogram was recorded and digitized using electrocardiography system (FCP–3255, SM–50, SCM–6000, FUKUDA DENSHI Co, Ltd), and BP were measured by ambulatory blood pressure monitor (FB–240, FUKUDA DENSHI Co, Ltd). High frequency component, LFC, and LF/HF were calculated from digitized data by computer software “Fluc1et”, hemodynamic and autonomic nervous activity automatic analysis system (Dainippon Pharmacy Co, Ltd). Many investigators analyzed HRV by “Fourier Transforms” It needs heart rate data of at least 256 or 512 beats, thus requiring 3 to 5 minutes. In this study, HRV was analyzed by “Wavelet Transforms” in order to detect immediate physiological change. “Wavelet Transforms” software used in this study has a time resolution of 0.1 second, thus it can find out momentary variation of one’s physiological responses.

Statistical analysis
Collected data were expressed as mean or median±standard error. The statistical analysis was performed using a paired t-test for HR, BP and HRV, and Wilcoxon signed–ranks test was performed for STAI and POMS. These analyses were calculated on statistical computer software “SPSS 11.5 J” (SPSS Japan Inc.). A probability level of less than 0.05 was considered significant.

Results

Psychological state

STAI
Trait anxiety score of STAI was less than 43 on all subjects. Significant improvement was not observed in male’s state anxiety factor. Significant improvement was observed in female’s state anxiety factor (Z=−2.12, p=0.034). Significant improvement was observed in all subject’s state anxiety factor (Z=−3.08, p=0.002) (Figure 2).

POMS
Significant improvement was not observed in male’s “Tension–Anxiety” factor. Significant improvement was ob-
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Figure 2. Comparison of State-Anxiety (STAI) index at pre and post “Foot Bathing”

Figure 3. Comparison of Tension-Anxiety (POMS) index at pre and post “Foot Bathing”

Figure 4. Comparison of Depression-Dejection (POMS) index at pre and post “Foot Bathing”

Figure 5. Comparison of Anger-Hostility (POMS) index at pre and post “Foot Bathing”

Figure 6. Comparison of Fatigue (POMS) index at pre and post “Foot Bathing”

Significant improvement was observed in male’s, female’s, and all subject’s “Depression-Dejection” factor ($Z=-2.00$, $-2.20$, and $-3.08$, $p=0.046$, 0.028, and 0.002) (Figure 4). Significant improvement was observed in male’s, female’s, and all subject’s “Anger-Hostility” factor ($Z=-2.00$, $-2.20$, and $-3.08$, $p=0.046$, 0.028, and 0.002) (Figure 5). Significant improvement was not observed in male’s “Fatigue” factor. Significant improvement was observed in female’s “Fatigue” factor ($Z=-2.20$, $p=0.028$). Significant improvement was observed in all subject’s “Fatigue” factor ($Z=-3.04$, $p=0.002$) (Figure 6). Significant improvement was not observed in male’s and female’s “Confusion” factor. Significant improvement was observed in all subject’s “Confusion” factor ($Z=2.55$, $p=$
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Figure 7. Comparison of Confusion (POMS) index at pre and post “Foot Bathing”

Figure 8. Comparison of Vigor (POMS) index at pre and post “Foot Bathing”

Figure 9. Comparison of Systolic BP at pre and post “Foot Bathing”

Figure 10. Comparison of Diastolic BP at pre and post “Foot Bathing”

Figure 11. Comparison of HR at pre and post “Foot Bathing”

Physiological state

Significant change was not observed in male’s, female’s, and all subject’s systolic BP factor at just before and after “Foot Bathing” (Figure 9). Significant change was not observed in male’s, female’s, and all subject’s diastolic BP factor at just before and after “Foot Bathing” (Figure 10). Significant change was not observed in male’s, female’s, and all subject’s HR factor at just before and after “Foot Bathing” (Figure 11). Significant difference was not observed in male’s, female’s, and all subject’s HFC factor at 5 minutes before and after “Foot Bathing” (Figure 12). Significant difference was not observed in male’s, female’s, and all subject’s LFC factor at 5 minutes
Discussion

In a comparison between male and female in psychological factor, male’s mood (state-anxiety, tension-anxiety, fatigue) did not improve, contrary to female’s mood. These results are interpreted that male’s mood is hard to improve and female’s mood is easy to improve by some intervention.

In this study, psychological and physiological indices were examined at the similar intervals before and after “Foot Bathing”. “Wavelet transforms” HRV has a time resolution of 0.1 second in this study, so HRV should reflect subject’s mood as revealed by STAI and POMS measurements. We expected physiological results to be consistent with subjective mood. Negative mood of all subjects (tension-anxiety, depression-dejection, anger-hostility, fatigue, confusion) significantly improved, however positive mood (vigor), BP, HR, and parasympathetic nervous activity, as reflected by the “Wavelet transforms” HRV, showed no significant changes. These results are consistent with previous studies. It seems probable that the assessment of “Wavelet Transform” HRV might be a part of the overall effects during “Foot Bathing”. Analysis using more parameters may demonstrate the reduction of sympathetic nervous system activity, for example at just after soaking foot, washing foot, or massaging foot. “These results are interpreted one’s physiological responses do not always reflect one’s psychological mood, responses of BP, HR, and HRV have time lag after the intervention, the physiological parameter we measured were not appropriate, and “Foot Bathing” as a nursing intervention can be improved one’s negative mood without affecting BP.
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HR, and HRV.

Further study with more subjects is needed to identify the relation between physiological and psychological states or time lag between the intervention and responses. Buckle (1) has shown that respiration became slower and deeper for 20 out of 24 postoperative patients receiving massage with essential oils. Another assessment of parasympathetic nervous activity probably exhibit changes of physiological states, for example using respiratory rate, peripheral circulation measured by thermography or blood flow, and movement of alimentary tract assessed by electro gastrogram. In addition, no changes in BP, HR, and HRV may indicate stable circulation kinetics of subjects. Therefore “Foot Bathing” is suggested to make subjects comfortable with little affecting on circulation kinetics.

In summary, this study clarified that “Foot Bathing” using this procedure appears to be a method of improving subjects’ negative mood, but without demonstrate physiological relaxation. The present results would contribute to develop the nursing intervention that improve patients’ negative mood without change in their circulation kinetics in the clinical situation.

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