The Effectiveness of Foot Reflexology Massage in Reducing Cortisol Saliva Levels as a Biomarker of Stress for Patients with Cancer

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\textbf{ABSTRACT}

Patients with cancer will experience limitations in meeting their daily needs, including psychological problems such as stress. Stress can be assessed through cortisol saliva as a biomarker of stress. Foot Reflexology will help restore the body's energy balance, stimulate relaxation and endorphins, and reduce stress. To determine the effect of foot reflexology to reduce salivary cortisol levels as a biomarker of anxiety for patients with cancer. Adult patients with cancer in stage II and III hospitalized in a Public hospital in Central Java, Indonesia, were invited. Foot reflexology was given once (40 minutes) a day. Saliva collection was carried out two times a day (30 minutes before intervention) and 15 minutes after intervention. Salivary cortisol levels at baseline and post-intervention were measured and compared to determine the effect of foot reflexology. Data were analyzed using the Wilcox on signed-rank and effect size (ES) test. Fifty-five patients (93.2\%) participated in this study. We found that the effect size of foot reflexology was 0.82 ($\rho = 0.001$) with a mean and standard deviation of salivary cortisol levels at baseline and post-intervention were (9.31 ± 5.45 and 6.17 ± 4.55) respectively. These findings indicated the significant effect of giving Foot Reflexology Massage in reducing salivary cortisol levels. Foot Reflexology massage is proven to have a substantial impact on reducing the Salivary cortisol level as a stress biomarker.

\textbf{INTRODUCTION}

Cancer is a big problem that can increase every country’s economic burden and become a significant cause of morbidity and mortality in the entire population, especially the elderly population (Rao and Cohen, 2004). Cancer is also a major health problem in low and middle-income countries in the Asia Pacific region and developed countries caused by increasing ageing populations and lifestyle changes related to economic development (Shin et al., 2012). In Indonesia, cancer treatment and care is a burden on the country's economy. According to data from the (Ministry Health
of the Republic of Indonesia, 2016), the State expenditure on cancer in 2012 was 144.7 billion IDR and increased in 2014 to 905 billion IDR. These costs are used for cancer management from diagnosis to treatment, such as chemotherapy and radiotherapy. Patients with cancer will experience limitations in meeting their daily needs and face physical problems (pain, fatigue, sleep problems, coughing, etc.), psychological issues, spiritual and financial problems (Nasution et al., 2020; Effendy et al., 2015). Also, extended treatment programs, insomnia, sexual dysfunction, and other symptoms will often occur during treatment (Sulistyawati et al., 2019; Wengström et al., 2000).

This condition will be a high stress or for cancer patients to trigger prolonged depression, anxiety, and stress (Edwards and Clarke, 2004). Furthermore, symptoms that arise due to cancer patients such as fatigue, insomnia, pain, or other symptoms can worsen anxiety and stress experienced (Carlson et al., 2019). Stress can be assessed quantitatively through active biological substances in body fluids related to stress. Stress will cause an increase in cortisol in the bloodstream. Cortisol is a hormone produced in the body due to increased activity of the hypothalamus-pituitary-adrenal (HPA) axis. Cortisol can be measured in saliva (saliva) and blood. Salivary cortisol is widely used as a diagnostic medium because of the content and benefits of sampling that does not require invasive action (Sharpley et al., 2017). Extraordinary progress is achieved by conventional treatments such as chemotherapy and anti-stress or anti-depressant administration. Still, the use of complementary alternative and medicine (CAM) is also very popular with Indonesian people.

CAM has been used as an alternative treatment among cancer patients with various disease diagnoses (Mansky and Wallerstedt, 2006). Cancer patients use CAM in the hope of relieving pain, improving the immune system, and helping to control side effects related to illness or treatment (Mansky and Wallerstedt, 2006). One CAM used in patients is foot reflexology. Foot reflexology is a holistic treatment based on the principle that there is a point or area on the feet, hands, and ears connected to other parts of the body or organs through the nervous system. Pressure or massage at the point or area will stimulate energy movement along the nerve channels that will help restore the body’s energy balance, improve the immune system, stimulate circulation, reduce pain and muscle tension, reduce stress, and optimize health and performance (Andrew and Dempsey, 2007). Massage therapy is recommended for anxiety and mood disturbance. It can be considered in patients suffering from pain who also have anxiety and mood disturbance (Deng, 2019). The biological stress response involves stress hormones such as nor epinephrine, epinephrine, and cortisol. Research shows that psychological stress can increase basal cortisol levels and decrease acute cortisol (Carlson et al., 2019). Research on foot reflexology on cortisol levels has been carried out, such as the (McVicar et al., 2007) study that used caterpillar techniques and (Mackereth and Booth, 2009) using the Ingham method (McVicar et al., 2007).

(Mackereth and Booth, 2009) There have also been many studies on foot reflexology in Indonesia. Still, so far, there has been no reported use of foot reflexology in cancer patients.) conducted a study of the effectiveness of foot reflexology in patients who were treated intensively research was conducted in patients with primary hypertension. In this study, foot reflexology Massage was guided by foot reflexology guidelines made by the Ministry of Education and Culture of the Republic of Indonesia (2016) and modified according to Indonesian society’s culture by adding several procedures and therapy points for stress. The Foot Reflexology Massage Procedure begins and ends with prayer, and uses aromatherapy oil in the massage process. This procedure is what distinguishes Foot Reflexology Massage from previous studies. This makes the researchers the basis for using Foot Reflexology Massage as a complementary therapy in cancer patients to reduce salivary cortisol levels as a biomarker of stress in cancer patients.

MATERIALS AND METHODS

Subject and Methods

Patient

This research was conducted from January to March 2018 with a pre-experimental design of one group pre and post-test design, involving 55 patients in two rooms at the referral hospital in Central Java, Indonesia. This study’s sample was cancer patients aged 18 to 65, experiencing stress (measured by DASS-42, Score 15-33), and conscious patients (GCS 13-15). Exclusion criteria included patients in an emergency, uncooperative, diagnosed with the disease (type 1 DM, epilepsy, mental disorders, DVT, Osteoporosis, chronic heart disease based on medical records), high fever, using prednisone drugs, anticonvulsants for more than six months, pregnancy, foot injuries, and regular foot reflexology. This research has received ethical approval from the Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health, and Nursing UGM No. KE/FK/1330/EC/2017.
Ethical permits and eligibility were also issued by the Hospital Ethics Commission Prof. Dr Margono Soekarjo, Purwokerto, Central Java, Indonesia with Number: 420/24094b/XII/2017. Patients have been given information relating to research, along with information and Consent forms. Confidentiality was ensured, and written Informed consent is obtained.

**Figure 1: Respondent Selection Chart.**

**Figure 2: Change of salivary cortisol.**

**Intervention**

The research subject becomes a control for himself. The research subject becomes a control for himself. The research subjects received foot reflexology therapy for a day with a 1 X 1-day dose at 40 minutes. Written informed consent was obtained from all patients before completing a 30-min. Foot reflexology is carried out by the established research protocol based on the guidelines issued by the Ministry of Education and Culture of the Republic of Indonesia (2016). Researchers have modified it during the massage phase: Pray before and after the massage, soak the patient's feet with warm water and salt, apply massage oil flavorful therapy, massage using basic techniques (Effleurance, Petrisage, Friction, vibration, and tapotement), massage at the opening point (point of Brain, cerebellum, Pituitary, and Vertebrae), mandatory point (detoxification, metabolism, digestion, relaxation, and supplements), therapy point (foot reflexology point for stress, namely Solar Plexus, Diaphragm, Pituitary, Lungs, Hypothalamus, Brain and backbone, heart, adrenal glands, pancreas, and Neck), closing point (Lymph Gland), and cooling massage (Effleurance, Petrissage, Friction, vibrating, and tapotement). During the massage process, the technician/therapist maintains communication with the patient.

**Measurement, data and specimen collection**

In this study, the salivary cortisol level was used as a biomarker of stress. Salivary cortisol has become a healthy index of HPA axis activity. Salivary cortisol levels were determined quantitatively using the ELISA method. The lowest cortisol level detected from the standard zero is 0.537 ng/mL or 0.0537 μg/dL, with a confidence level of 95%. Saliva collection was carried out two times a day, i.e., one time at baseline (30 minutes before intervention) and one time in post-test (15 minutes after intervention). Taking is done by asking respondents to drain saliva into a storage bottle. Taking saliva specimens is carried out 2-3 hours after eating. Saliva should not be contaminated with blood. After finishing taking saliva specimens, they are then stored in a cooler.
Table 1: Demographic Characteristics.

| Characteristics          | f  | %    | Mean ± SD       |
|--------------------------|----|------|-----------------|
| **Sex**                  |    |      |                 |
| Male                     | 24 | 43.6 |                 |
| Female                   | 31 | 56.4 |                 |
| **Age**                  |    |      |                 |
| 20-40 years old          | 9  | 16.4 |                 |
| >40 – 60 years old       | 38 | 69.1 | 48.98 ± 9.53    |
| >60 years                | 8  | 14.5 |                 |
| **Min-max Age** (24-65 years old) |  |  |                 |
| **Income**               |    |      |                 |
| <IDR 1,400,000           | 46 | 83.6 |                 |
| ≥ IDR 1,400,000          | 9 | 16.4 |                 |
| **Type of Cancer**       |    |      |                 |
| Nasopharynx              | 18 | 32.7 |                 |
| Cervix, Ovary            | 7  | 12.7 |                 |
| Kolon, Rectum, Sigmoid   | 20 | 36.4 |                 |
| Breast                   | 3  | 5.5  |                 |
| Other (Intraabdomen, Ileum, Pangkreas, Thyroid, Caecum, Testicular Seminoma) | 7 | 12.7 |                 |
| **Length of Sickness**   |    |      |                 |
| ≤6 months                | 31 | 56.4 |                 |
| >6 months                | 24 | 43.6 |                 |
| Average Length of Sickness (months) |  |  | 9.49 ± 10.85 |
| **Type of therapy**      |    |      |                 |
| Chemotherapy             | 16 | 29.1 |                 |
| Surgery and Chemotherapy | 39 | 70.9 |                 |

at 2°C-8°C. The salivary specimens were then taken to the laboratory to be analyzed by a laboratory with the method of Human Salivary Cortisol Elisa, Kit 96 wells DRG SLV-2930.

Statistical Analysis

Based on some previous studies on the effects of reflexology on salivary cortisol levels in cancer patients and included in the sample formula by considering the impact of the difference of 0.03, it was found that the number of samples was 38 respondents with consideration of dropping 10%. But in data collection, there were 120 respondents available. The number of patients who met the criteria and eligible to be used as respondents was 55 patients.

Demographic data are presented in frequency distribution tables (f) and percentages (%) for categorical data, numeric data are expressed in mean and standard deviation. Stages of analysis are a normality test, Hypothesis test, and large effect test. The normality test for the difference in mean cortisol using Kolmogorov-Smirnov (n = 55), \( p > 0.05 \). The researcher also calculates the ratio of mean, median and standard deviation (SD); \( 0.9 \leq \frac{\text{mean}}{\text{median}} \leq 1.1; \frac{\text{SD}}{\text{mean}} < 0.33 \) (30%).

![Figure 3: Boxplot of cortisol on baseline and Post Intervention.](image)

The statistical test on the outcome tested the difference in mean baseline and post-intervention cortisol levels using the Wilcoxon Signed Rank Test statistical test, with a significance value of \( p <0.05 \).
Table 2: The effect of foot reflexology on salivary cortisol levels in cancer.

| Level of Salivary Cortisol | Average Difference Value of Cortisol Saliva Level and Test of Size Effect |
|----------------------------|-------------------------------------------------|
| Baseline                  | 8.99 (1.719-24.011)                               |
| Post Intervention         | 4.99 (0.241-21,489)                              |

The test of the effect on the Wilcoxon signed-rank test was obtained by comparing the Z score’s worth with the total number of study respondents square root. Interpretation of a large amount of the effect is if ES 0.1 means a minor effect, a value of 0.3 represents a medium effect, and a value of 0.5 indicates a large effect. Data were analyzed using SPSS.

RESULTS AND DISCUSSION

The screening process was carried out in 120 patients treated in two rooms. The number of patients who met the eligibility criteria to be used as respondents was 59 patients, and 61 patients did not meet the requirements due to a weak general condition, unwillingness to become respondents, trauma/injuries/swelling in the legs, over 65 years old, stage IV cancer, receiving other complementary therapies, getting pregnant, going home, history of diabetes and hypertension, shortness of breath, and no complaints of fatigue. The selection of respondents can be seen in the following chart Figure 1.

Demographic Characteristics and Distribution of Cortisol Saliva Levels

Based on Table 1, it can be seen that the majority of research respondents were female (56.4%) and aged between 40 years to 60 years (69.1%) and the average age of 48.98 years. Table 1 shows that nasopharyngeal cancer (32.7%) and colorectal (36.4%) were the most common cancer events in the study respondents. The mean length of illness was 9.49 months, with the dominant duration of disease less than six months (56.4%). Medical therapy undertaken by respondents was having undergone surgery and while undergoing chemotherapy as much as 70.9%.

Figures 2 and 3 show that salivary cortisol levels have a minimum-maximum value, i.e., at the pre-intervention measurement stage of 1.719 ng/mL - 24.011 ng/mL, post-intervention is 0.241 ng/mL — 21.489 ng/mL. The calculation results obtained an average value and standard deviation for each baseline of 9.31 ± 5.45 and posted an intervention of 6.17 ± 4.55. This distribution also shows that four research respondents experienced increased salivary cortisol levels after being given an intervention. The change in median value is also seen in Figure 3. The median difference in salivary cortisol levels between baseline and post-intervention was 4.00, which resulted from a reduction in the median baseline value of 8.99 and the median value of the post-intervention was 4.99. This shows that the median difference of the two measurements is more than 0.3 so that clinically there is an effect of foot reflexology on decreasing salivary cortisol levels in cancer patients.

Effects of Massage Foot Reflexology on Salivary Cortisol Levels

A hypothetical test is done using the Wilcoxon Signed Rank Test, and then a large test of the effect is carried out. This test was conducted to determine the effect of foot reflexology on salivary cortisol levels as a biomarker of stress in cancer patients. These results can be seen in Table 2. Table 2 and Figure 3 show that the difference in the median Level of Salivary cortisol between baseline and Post-Intervention is 4.00, resulting in a reduction in the median baseline value of 8.99 and the median value of Post-Intervention of 4.99. This shows that the median difference value of the two measurements is more than 0.3 so that clinically there is the effect of foot reflexology on decreasing the Degree of Salivary cortisol in cancer patients.

Based on Table 2, the Wilcoxon signed-rank test results between baseline and Post-Intervention tests showed that ρ = 0.001 (ρ <0.05). This indicates that statistically, there is a significant influence on foot reflexology to decrease the Degree of Salivary cortisol in cancer patients. The test results obtained from the value of Z divided by the square root of the total sample so that ES is obtained at 0.82 (ES> 0.5). Therefore, it can be concluded that foot reflexology has a significant effect on decreasing the degree of salivary cortisol in cancer patients. In this study, it was found that foot reflexology affected the decrease of the Degree of Salivary cortisol as a biomarker of stress in cancer patients both statistically (ρ = 0.001) and clinically. The clinical effect can be seen in reducing the Degree of Salivary cortisol in cancer patients after seeing the results of...
differences in baseline and Post-Intervention measurements. Foot reflexology has a significant effect on decreasing the Degree of Salivary cortisol (ES by 0.82; ES > 0.5).

Similar investigations are revealed in Hodgson and Lafferty’s findings that foot reflexology significantly decreases the Degree of Salivary cortisol, but with a small effect, ES = -0.13. The results of (Mackereth and Booth, 2009) also reported changes in the Degree of Salivary cortisol after being given a foot reflexology intervention, with an ES value of 0.44 (moderate effect). Another study comparing foot reflexology and Scalp massage also reported decreased serum cortisol levels in both treatment groups (Green et al., 2010). The positive effect of giving foot reflexology to a reduction in the Degree of Salivary cortisol in cancer patients is found to reduce stress by stimulating a relaxation response and improving mood. The process is described as follows:

Reducing stress by stimulating a relaxation response

The findings in this study reveal that foot reflexology positively impacts reducing stress by stimulating a relaxation response. This can be seen from cancer patients reaction when the initial massage seemed tense and felt worried/anxious to be calmer and enjoy every massage given. Research respondents also revealed that feeling happy and comfortable when given a massage and drowsiness arises when foot reflexology occurs. Another finding was expressed by (Puthusseryl, 2006) that by massage, the patient will receive attention and touch, which is an essential element of care that supports comfort and well-being, and gentle touch regularly will increase relaxation (Puthusseryl, 2006). In this study, before the respondents were given foot reflexology in areas of the reflection point, a warm-up massage was given and ended with a cooling massage.

This technique has benefits in promoting blood circulation, maintaining good health, helping to reduce pain, stimulating the production of endorphins which function for relaxation, reducing the burden of thoughts caused by stress. Stress, anxiety, and tension are associated with hormones produced by adrenals. Stress causes regulatory disorders in the HPA (hypothalamus-pituitary-adrenal) axis system, which can be evaluated through cortisol (Chen et al., 2013; Korszun et al., 2002). Plasma cortisol levels correlate with the Degree of Salivary cortisol. Cortisol is the primary glucocorticoid circulating and released by the adrenal gland, controlled by pituitary through the release of adrenocorticotropic hormone (ACTH) and corticotrophin-releasing hormone (CRH). Foot reflexology is a manipulation of soft tissue structures that can soothe and reduce psychological stress by increasing stimulation of endogenous opioid systems such as endorphins, enkephalin, and diamorphine while reducing hormones such as cortisol, dopamine, and norepinephrine (Best et al., 2008).

Endorphins are derived from Proopiomelanocortin (POMC), which is only synthesized in a limited area of the brain. Endorphin neurons are located in the arcuate ventromedial nucleus in the hypothalamus along with the size of the brain, including in the Ventral Tegmental Area (VTA), Nucleus accumbens (Nac), amygdala, and other parts of the hypothalamus (Al’Absi, 2007). Endorphins are neurotransmitters that can help improve mood, well-being, reduce feelings of anxiety and reduce the activity of the HPA axis, which ultimately can reduce or balance the production of the hormone cortisol in the body (Lindfors and Lundberg, 2002). Another factor influencing the foot reflexology’s success in increasing relaxation stimulation is to pray before and after the massage. Praying is part of the protocol for giving foot reflexology given by the research respondents beliefs and religion. Praying is a psychological therapy that can reduce the stressors experienced by a person through psycho-neuro-endocrine tissue.

Improve mood

Giving foot reflexology will improve or improve the mood of the respondent. This finding was revealed from researchers’ observations who saw patients appear calm and happy when given a massage in the respondent’s feet. Also, researchers maintain communication with respondents, so they do not feel awkward or embarrassed to feel comfortable. The respondent’s statement also revealed that they were pleased to get a massage even some were asked to get a massage every day. Foot reflexology can help reduce anxiety, pain, fatigue, smooth blood vessel circulation, balance energy in the body, provide comfort, and improve mood disorders. Massage will stimulate serotonin release, increase the number of NK cells, and lymphocytes. Serotonin is a neurotransmitter that functions and works to regulate mood, sleep, and appetite (Hernandez-Reif et al., 2004).

The use of scented massage oil in the foot reflexology procedure can help stimulate the relaxation response and improve the mood research respondents moods. Another finding was revealed by (Fradelos and komini, 2015) that the use of scented oil could improve physical and mental well-being and improve mood. The use of aromatic oils





can be combined with various complementary and traditional treatments, one of which is foot reflexology (Harrison, 2008). Based on these data, it can be assumed that the effect of foot reflexology on the mood can not only occur due to the impact of massage on the point of reflection, but the interaction between therapist and respondent or interpersonal interaction, and the use of aromatherapy oils. The benefits of massage can be felt differently between individuals; this depends on his personality. Mood improvement will reduce the stress of respondents, which will affect the decrease in the Degree of Salivary cortisol (Listing et al., 2009). This is that the patient’s respondents’ square root, such as smoking and drinking coffee or alcohol, were not collected and analyzed in the study, so they could not know the relationship with the Degree of Salivary cortisol.

CONCLUSIONS

Foot Reflexology is proven to be beneficial and has a significant effect on reducing the Degree of Salivary cortisol as a stress biomarker by stimulating the relaxation response and improving mood in cancer patients.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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