European Journal of Integrative Medicine 12 (2017) 79–86

Contents lists available at ScienceDirect

European Journal of Integrative Medicine

journal homepage: www.elsevier.com/locate/eujim

Research paper

The effects of aromatherapy essential oil inhalation on stress, sleep quality and immunity in healthy adults: Randomized controlled trial

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ARTICLE INFO

Keywords:
Aromatherapy
Stress
Depression
Sleep
Immunity
Essential oil
Randomized controlled trial

ABSTRACT

Introduction: Stress can lead to poor sleep and compromise immune function and it is important to identify approaches that can address such problems and improve quality of life. The aim of this randomized controlled trial was to examine whether aromatherapy via inhalation of essential oils could relieve perceived stress, depression, and improve sleep quality, and immune function.

Methods: Subjects aged 20–60 years responding to a recruitment advertisement posted in a general hospital were randomly assigned into either an aromatherapy group (n = 30) or a waiting list control group (n = 30). The subjects in the experimental treatment were asked to inhale an essential oil blend of lemon, eucalyptus, tea tree, and peppermint in a ratio of 4:2:2:1. The essential oil blend was inhaled by wearing a pendant during the day and sleeping near an aromatherapy stone at night for four weeks. Perceived stress, stress index, autonomic nervous system (ANS) activation, and glycated hemoglobin (HbA1c) levels were measured to examine stress. In addition, depression was measured using the Center for Epidemiologic Studies Depression Scale (CES-D). Sleep quality and immune state were also measured.

Results: The aromatherapy group had significantly lower perceived stress levels ($p < 0.001$) and depression ($p = 0.049$) and significantly higher sleep quality ($p = 0.001$), but the two groups did not differ in terms of ANS activation, HbA1c levels, or immune status.

Conclusions: In conclusion, inhalation of essential oils as per aromatherapy, resulted in lower perceived stress and depression, as well as better sleep quality, but did not influence physiological parameters, such as the stress index or immune state.

1. Introduction

Infectious disease epidemics, such as herpes, herpes zoster, cold, influenza, and swine flu, as well as the increasing prevalence of chronic diseases, such as cancer have been associated with an increase in stress and reduced immunity to infection [1,2]. This has in turn has inspired vigorous research on the relationship between stress and sleep, and the role of stress, infection, and immunity [3]. Several medical and non-medical measures to relieve stress, improve sleep quality, and boost immunity have been proposed [4,5]. Stress relief, improvement of sleep quality, and improvement in immune function are key factors not only in prolonging a healthy lifespan, but also in increasing quality of life.

Stress is a concept derived from physics and engineering, adopted by psychology and biology. It has been defined as an atypical physiological reaction that arises within the body in response to imagined or actual injury and various stimuli inflicted on the body [6]. Symptoms of stress may include reduced judgment, excessive worrying, instability, agitation, depression, pain, digestive symptoms, nausea, vertigo, chest pain, tachycardia, increased or reduced appetite, increased or decreased sleep, social withdrawal, drinking or smoking, and increased drug intake [6]. While there are many symptoms of stress as outlined above, depression is frequently associated with stress. Depression refers to “negative emotions,” and presents as an imbalance of neurotransmitters, such as dopamine, serotonin, and norepinephrine. Major symptoms of depression include lethargy, anxiety, sleep disturbances, loss of interest, suicide, and physical symptoms, such as

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http://dx.doi.org/10.1016/j.eujim.2017.04.009
Received 17 March 2017; Received in revised form 20 April 2017; Accepted 24 April 2017

headache and indigestion [7].

Sleep difficulties are also associated with stress and are often also related to depression. Maintaining quality of sleep is especially important to overall health, as reduced sleep caused by stress is related to decrease immune function [8,9]. During sleep, the body's sensory activities and voluntary muscles are suppressed, and interaction with the environment is reduced. Sleep is divided into non-rapid eye movement (NREM) and rapid eye movement (REM) phases; a sleep cycle begins with NREM sleep and progresses to REM sleep, and is repeated 4–5 times a night in 90-min intervals. NREM sleep is characterized by recovery of the body's tissues, while REM sleep is characterized by increased protein synthesis and recovery of brain tissue functions, in addition to physical and psychological recovery [8,10]. Various factors interrupt sleep, but depression has been specifically correlated with sleep disorders in many studies. For example, individuals with more severe insomnia have shown increased depression severity, demonstrating a positive correlation between sleep disorders and depression [11]. There is a cyclical relationship between these factors such that depression induces sleep disorders, and sleep disorders result in depression [12]. Therefore, ensuring an adequate amount of sleep and improving sleep quality could be one method to relieve stress and depression.

Immune function is also closely related to stress and depression. Immunity refers to a host's resistance to non-self substances [13]. Several recent studies have suggested that emotional factors play a central role in immune function. For example, chronic stress particularly influences the brain, hormones, visceral fat, and immune system. Specifically, chronic stress reduces memory and increases stress hormones and visceral fat, which in turn makes the host vulnerable to various diseases, such as heart and infectious diseases. For example, it has been reported that social disruption causes changes in immune cell reaction to infection, resulting in respiratory inflammation [14]. Furthermore, depression not only decreases atypical immune responses, but also activates inflammatory processes; therefore, herpes zoster is especially more risky and severe in older individuals and those with depression [15]. Stress has also been reported to heighten individual's vulnerability to infectious diseases, as evidenced by an assessment of antibody responses to an influenza vaccine in a stressful situation [16]. Taken together, these findings suggest that stress is associated with immunity, a connection that has been proposed since the discovery of stress by Hans Selye [9].

In conclusion, developing antibiotics and devising measures to enhance immune function have become highly important due to various epidemic outbreaks and the rise in the prevalence of chronic diseases. There have been continuous advances in developing anti-stress measures, sleep quality improvements, medical and nursing interventions, including antimicrobial and immune-enhancing techniques, as well as the use of complementary and alternative medicine (CAM) treatments. Traditional treatment of infectious diseases typically involves antibiotics, and nursing interventions which can involve helping patients to overcome disease through comfort and rest. In addition, CAM to relieve stress has included: meditation, music therapy, art therapy, aromatherapy, Tai chi, yoga, and laughter therapy.

Aromatherapy uses essential extracts from plants, specifically, the use of herbs and their essential oils. Several essential oils used in aromatherapy have been suggested to have antimicrobial effects, preservative effects, anti-stress effects, anti-depressive effects, anti-inflammatory effects, relaxation effects, and immune-enhancing effects [17]. Essential oils that are recommended for aromatherapy include tea tree, cinnamon, clove, eucalyptus, thyme, rosemary, lavender, pine, and tea tree oil, which is one of the more well-known immune-enhancers [17]. The recommended methods of using these essential oils are through bath, inhalation, and massage.

Literature pertaining to the anti-stress effects of aromatherapy is accumulating in Korea and abroad, and the evidence of anti-stress effects produced by CAM therapies have been adequately established [18]. However, there is still a lack of evidence supporting the theory that stress depresses immune function and decreases quality of sleep. Several studies have examined anti-stress effects of the use of aromatherapy essential oils [19–21], but such studies are still few in number, with a particular scarcity of research on immune-enhancing effects of essential oils. Despite the significance of immunity in inhibiting disease morbidity, it is difficult to measure immunity. In addition, although several parameters could be used to measure immunity, these are also difficult to study because they are influenced by various situational, psychological, and physical factors. Therefore, there is still a lack of research on the immune-enhancing effects of aromatherapy, which suggests there is a need for additional studies on this matter, as prevalence of various infectious diseases is on the rise and many diseases are caused by decreased immune function. Several essential oils used for aromatherapy have been suggested to have immune-enhancing effects, and researchers are beginning to verify these effects. For example, a study that examined the effects of lavender on citrobacterrodentium-induced enteritis found that lavender had immune-enhancing effects [22]. Moreover, another study examined the effects of aromatherapy provided through Thai massage using coconut oil containing ginger oil on colorectal cancer patients receiving chemotherapy; measurements of patients' T-lymphocytes, and cluster of differentiation 4 (CD4), CD8, and CD4/CD8 counts revealed that aromatherapy was effective in enhancing cell mediated immunity [23].

The present study seeks to verify the stress relief and immune-enhancing effects of aromatherapy essential oil inhalation. Ultimately, the aim of this study was to investigate whether the quality of life of individuals could be improved by relieving stress and enhancing immunity.

2. Methods

2.1. Study design

The present study adopted a randomized controlled trial design to compare the effects of aromatherapy oil inhalation on adults' stress, depression, sleep quality, and immunity (Fig. 1).

2.2. Subjects selection and randomization

2.2.1. Selection and assignment of subjects

Study candidates were adults who were enrolled through a recruitment advertisement posted at a general hospital between September 2015 and October 2015. Participants were randomly assigned to either the aromatherapy group or the waiting list group. The inclusion/exclusion criteria were as follows: adults aged 20–60 years old, full capability of communicating, no auditory or olfactory problems, no psychiatric disorders, and not currently taking any medications associated with enhancing immune function. All participants provided written informed consent and the protocol was approved by the Institutional Review Board at E hospital (EMCIRB 15–83). In addition participants were informed that they could withdraw from the study at any time without any repercussion.

2.2.2. Sample size calculation and randomization

Sample size was calculated using G*power by entering the significance level (α), statistical power (1-ß), and effect size (effect size). To compare the means of the two groups, a medium effect size was set at 0.80, level of significance was 0.05, and statistical power was 0.80, with two equivalent groups. The G*power calculation suggested a total sample of 52 participants, with 26 in each group. In consideration of a 15% withdrawal rate, a total of 60 individuals were enrolled, with 30 randomly assigned to each of the aromatherapy and waiting list groups. Subjects were randomly assigned using a computerized random generator. None of the participants withdrew during the study, resulting in 30 participants in the aromatherapy group and 30 in the waiting list