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ORIGINAL RESEARCH

Effect of Vibratory Massage Hammer on Superoxide Dismutase (SOD) and Catalase Levels in Undergraduate Students of Olabisi Onabanjo University

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Abstract:
Introduction: To date, only a few studies have attempted to monitor the changes in antioxidant enzyme levels by using massage.
Aim: The aim of this study was to determine the effects of massage on SOD and catalase antioxidants in undergraduate students of Olabisi Onabanjo University.
Methods: Ten (10) subjects from the Physiology department, Olabisi Onabanjo University were recruited for the study via personal contact. The participants received a vibratory massage at the back for 10 days. Data from 10 participants were used for analysis. All subjects were healthy as confirmed by their medical history and were not taking any medications.
Results: There was a significant decrease ($p < 0.05$) in the antioxidant enzyme SOD level while a non-significant decrease ($p > 0.05$) in catalase level in the subjects under experiment when results at the end of experiment was compared to baseline result.
Conclusion: The result of this present study showed that vibratory massage hammer may be an effective strategy for reducing pain, since as observed that there was a decrease in antioxidant enzymes (SOD and catalase) activity in normal individuals as ROS or free radicals were eliminated from relief. Hence, a vibratory massage hammer is useful in the prevention and treatment of diseases-state associated with oxidation: stress, pain, injury.
Keywords: Vibratory massage, SOD, Catalase, Antioxidant enzyme, Students

All co-authors agreed to have their names listed as authors.

1 INTRODUCTION

Oxidative stress is an imbalance between the pro-oxidant (free radical) and antioxidant defense system, which is of advantage for free radicals when present. Free radicals are composed of one or more unpaired electrons [1]. Free radicals are unwanted substances produced by cells as the body processes food and reacts to the environment [2]. If the body cannot process and remove free radicals effectively, this can result in oxidative stress. More so, it can harm cells and the functioning of the body. Free radicals are also known as reactive oxygen species (ROS) [3], and excessive amounts of it, which are produced naturally by metabolic processes, may cause cell damage by oxidation [4, 5]. In such events, the cell membrane, DNA, and other cellular structures may become damaged and subsequently, the cells become dysfunctional or mutated depending on the extent of damage, and pain may occur due to the substances generated during this process [6]. The antioxidant defense system has both endogenous (superoxide dismutase, catalase, glutathione etc.) and exogenous (carotenoid, tocopherol, etc.) defense agents [7]. These exogenous antioxidants have been segregated by fruits and vegetables [8], while endogenous antioxidants have been segregated by ultra-free radicals [9]. Excessive production of free radicals depends on many factors, such as environmental pollution, excessive food intake [10] and physical activity [11]. Oxidative stress has been known to cause some diseases which includes cardiovascular, DNA and cell damage, heart disease, cancer, arthritis, stroke, respiratory disease, immune deficiency, emphysema, parkinson's disease, and other inflammatory or ischemic conditions [2, 12-14]. Antioxidants are substances that can prevent or slow damage to cells caused by free radicals, unstable molecules that the body produces as a reaction to environmental and other pressures [3]. Antioxidants are said to help cancel the effect of free radicals in our bodies, and this is thought to boost overall health [3]. The anti-oxidation in the defensive system of the organism terminates these reactions by elimination of free radicals' mediators and inhibits oxidation reactions by their auto oxidation [15]. Massage is one of the most popular treatment methods used for the prevention of fatigue after thorough muscular activity and of muscle damage. Lately, studies have identified the intracellular mechanisms and physiological effects triggered by massage. Specifically, studies have reported that the levels of cytokines, including interleukin-6 (il-6) and tumor necrosis factor-alpha (TNF-α), which increases following the inflammatory response and micro-rupture of tissues due to muscle injury or strenuous exercise, and also, nuclear factor-kb (NF-kb), which is a transcription factor activates these cytokines, were reduced significantly by massage [16, 17]. NF-kb is especially sensitive to oxidation and is known to activate inflammatory cytokines when it is stimulated by ROS [18]. When ROS activate the signaling systems, such as NF-kb or mitogen-activated protein kinase, or disturb their homeostasis, cells may proliferate abnormally or mutate [19]. Cells have various antioxidant enzymes and chemicals for removing free radicals [20]. The antioxidant enzymes that protect the body by eliminating free radicals generated by oxidative stress include superoxide dismutase (SOD), catalase (CAT), glutathione-peroxidase (GPX), and glutathione s-transferase (GST) [21, 22]. Cai *et al*. [23] reported that the level of antioxidant enzymes was increased after a massage intervention was applied to obese elderly women. Moreover, results from a randomized double-blind study revealed that the pain experienced by patients with chronic pancreatitis was reduced after they were treated with antioxidants [24]. In the literature, there were many studies examining the effects of massage on biochemical parameters and the effects of acute exercises on oxidative stress [25-26]. Cai *et al*., [23] reported that the level of antioxidant enzymes was increased after a massage intervention was applied to obese elderly women. Moreso, results from a randomized double-blind study revealed that the pain experienced by patients with chronic pancreatitis was reduced after they were treated with antioxidants. Recently, home healthcare devices, such as vibratory hammer massage devices, with massage and infrared functions, have been developed and are commercially available. Among these devices, some products have already received approval from various countries, to be used as medical devices for reducing oxidative stress. However, few studies have evaluated the pain alleviating effects of vibratory massage hammer, and to determine its effect on antioxidant enzymes (SOD and catalase) activity which are determinant of reduction in free radicals causing oxidative stress, especially in the use of healthy young adults for 10days consecutively as found in this study.

2 MATERIALS AND METHOD

2.1 Materials

The following materials were used in conducting this study: appliance- electric dolphin massage hammer, labware and instruments (micropipette, micropipette tips, micropipette tips rack, spectrophotometer), blood sample collection; cotton wool, alcohol swab, medical gloves, syringe (5 ml), lithium heparin and, Ethylenediamine tetra acetic acid, (EDTA) bottles.

2.2 Method

Ten (10) subjects from the department of Physiology, Olabisi Onabanjo University (OOU) were recruited for the study via personal contact. All subjects were apparently healthy as confirmed by their medical history and were not taking any medications. They have also never experienced any adverse effects related to acupuncture nor did they suffer from skin lesions from previous acupuncture. Random numbers were used to assign subjects to the experimental group. Ethical

guidance of conducting animal research and care in Olabisi Onabanjo University, animal house was adhered to strictly.

2.3 Massage Procedures

Following a 10 minutes baseline recording, subjects received a strong vibratory massage at 60Hz. Subjects in all conditions received 10 minutes of stimulation to the back and shoulder by a trained therapist, while sitting fully clothed in a standard massage chair. The moderate pressure massage consisted of moderate pressure stoking and vibration - the vibratory massage hammer consisted of thumper (hand held massager) vibrating at 50Hz/60Hz on the strong pressure setting. The massage therapists were trained on the protocol and did not play another role in the study. All therapists were kept blind to the pressure hypothesis. Intermittent re-evaluation by the researchers ensured protocol compliance, especially with respect to the amount of pressure provided.

2.3.1 Determination of Catalase Activity

Catalase activity was determined according to the method of Sinha [27].

2.3.2 Determination of Superoxide Dismutase (SOD) Activity

The lead of SOD activity in plasma was determined by the method of Misra and Fridovich [28].

2.4 Statistical Analysis

All calculations were done using SPSS-version 25.0 statistical software package for the analysis of the data. The data are presented as mean $\pm$ standard error of mean (SEM) and statistical analysis carried out using the student's t-test and ANOVA. Values were considered to be of statistical significance when $p < 0.05$.

2.5 Results

Table 1: Effects of Vibratory Massage Hammer on Catalase in Undergraduate Students of Olabisi Onabanjo University

Sessions	Mean $\pm$ SEM (u/ml)	P-Value
Pre-test	18.29 $\pm$ 3.89	0.83
Post-test	12.50 $\pm$ 3.27	

Non-significant ($p>0.05$) when compared with control. N=10 *$p<0.05$ is significant.

Table 2: Effects of Vibratory Message Hammer on Superoxide Dismutase (SOD) In Undergraduate Students of Olabisi Onabanjo University

Sessions	Mean $\pm$ SEM (u/ml)	P-Value
Pre-test	745.39 $\pm$ 483.47	0.00
Post-test	124.41 $\pm$ 46.699	

Significant ($p<0.05$) when compared with control. *$p<0.05$ is significant.

As shown in Table 1, there was a non-significant decrease ($p>0.05$) in catalase level when post-test was compared to pre-test. As shown in Table 2 above, there was a significant ($p < 0.05$) decrease in superoxide dismutase of post-test when compared to pre-test.

3 DISCUSSION

To date, only a few studies have attempted to monitor the changes in antioxidant enzyme levels and pain by using massage. Vibratory hammer massager was used to determine the effects in the antioxidant enzymes (SOD and Catalase) levels in the normal individuals. The non-significant decrease in the level of catalase activity showed that there were no ROS and free radicals (which cause pain, inflammatory response to oxidative stress, and fatigue due to lactic acid build-up) in the body due to continuous daily massaging. Previous studies reported that antioxidant enzyme levels were increased after thermal stimulation in elderly individuals with back pain [29]. Also, Karabulut *et al.,* [30] concluded in their findings that continuous physical activities and massage manipulations significantly increase antioxidant activities which supported the assumption that regular physical activity has positive health effects. Results from this study suggested that elimination of free radicals, and later reduction in the absence or reduced ROS or free radical is the cause for reduction in SOD and Catalase in normal individuals. This was in conformity with Aguilo *et al.,* [31] and Berzosa *et al.*, [32] that stated that antioxidant defense systems produce antioxidants in order to eliminate or prevent the negative effects of increased production of free radicals. Enzymatic antioxidants have an important role in the antioxidant defense system. There were various causes of pain, including strenuous exercise or musculoskeletal injury, inflammatory response to oxidative stresses, including ROS, and fatigue due to lactic acid build-up [33]. Watkins *et al.* [34] suggested that inflammatory cytokines, including il-1ß, which are released from the microglial cells in the peripheral and central nervous system (CNS), are associated with pain, and that ROS can cause chronic pain by activating the glial cells in the CNS. Perez *et al*., 2003 Reported that the symptoms of complex regional pain syndrome type I (CRPS-I) were reduced after the administration of ROS scavengers [35]. Consequently, pain al-

leviation is also achieved with improved antioxidant function, which protects against ROS. GPX plays a secondary role in removing the remaining hydrogen peroxide after the action of cat on hydrogen peroxide [36]. In normal metabolism (i.e., without the influence of stress conditions), a balance exists between the generation of ROS and other pro-oxidants, and their detoxification and removal by antioxidant defense mechanisms. However, either an increase in ROS production above the level that can be removed by antioxidant defenses, could result in oxidative damage to key molecules, including DNA, protein and lipids (lipid peroxidation) [37]. The biological effects of antioxidant defenses and oxidative stress end products can be summarized as follows; under the normal physiological conditions, there is a critical balance in the generation of oxygen free radicals and antioxidant defense systems used by organisms to deactivate and protect themselves against free radical toxicity [38]. The pro-oxidant / antioxidant balance and detoxication of potentially damaging ROS was crucial for cellular homeostasis [39]. The decrease in oxidative stress may be a reason for decreased antioxidant defense systems, as a result of decreased endogenous production of the free radicals. Thus, the formation of antioxidant enzymes during development is related to the changes in the levels of free radicals [40]. In this present study, it showed that decrease in SOD and catalase may be the cause of free radical or ROS that has been eliminated in normal individuals after the use of massage daily for 10days. Therefore, massage may help in the pro-oxidant/antioxidant balance and detoxication of potentially damaging ROS which is crucial for cellular homeostasis.

4 CONCLUSION

In conclusion, the findings of this study shows that a vibratory massage hammer may be an effective strategy for reducing pain, oxidative stress and help in the pro-oxidant/antioxidant balance and detoxification of potentially damaging ROS which is crucial for cellular homeostasis. Vibratory massage hammer may, therefore, be useful in the prevention and treatment of diseases associated with oxidation: stress, pain, injury. The use of it as a home healthcare device is advisable.

AUTHORS' CONTRIBUTIONS

All authors participated actively in this research work and have read and approved the final manuscript.

CONSENT

Consent form has been approved by all authors.

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