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EFFECT OF YOGA TRAINING ON SUPEROXIDE DISMUTASE LEVELS IN ADULT

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ABSTRACT

Due to its capacity to enhance both physical and emotional wellbeing as well as to treat several medical illnesses like diabetes, cardiovascular disease, and chronic pain, yoga has become increasingly popular on a global scale. Yoga's ability to increase the body's antioxidant levels, especially those of superoxide dismutase (SOD), which may have anti-aging benefits, is one potential benefit. Although the precise mechanisms are still unclear, regular yoga practice has been found to raise SOD levels. Possible processes include hormesis-induced antioxidant defense mechanism stimulation and deep breathing-induced relaxation promotion and enhanced oxygenation. This review of the literature identifies gaps and restrictions in the research while providing an overview of the current studies on the impact of yoga on antioxidant levels. A comprehensive search was conducted for articles being published from 2013-2023. 455 articles were found. After reviewing the articles, 451 research articles were excluded, a total of 4 studies were included in this review. The best type of yoga and length of yoga practice for maximum antioxidant benefits are still being determined. However, the mechanism of action in which yoga had antioxidant effect to the body is by hormesis, by encouraging the creation of ROS, which in turn stimulates the body's antioxidant defense mechanisms, such as the generation of SOD. Overall, practicing yoga may have the ability to increase antioxidant status and enhance general health and wellbeing.

Keywords : antioxidant enzyme; obesity; yoga; exercise

INTRODUCTION

Superoxide dismutase (SOD), a potent antioxidant, is crucial for the body's defense against oxidative stress. SOD is regarded as an enzyme that fights aging. Derham Harman put forth the free radical theory of aging. When Drosophila flies aged, their loss of olfactory behavior was accelerated by a 75% reduction in SOD activity. Novel SOD mimics have been proposed as potential treatments for aging-related cognitive impairments and other physiological deteriorations.[1] There is growing evidence that regular yoga practice may increase SOD levels, perhaps having positive effects on anti-aging. Age-related decreases in the body's natural capacity to combat oxidative stress raise the risk of chronic diseases and other age-related health problems.[2] Numerous theories have been put forth to explain how yoga could boost antioxidant levels. Yoga poses may, for example, boost the generation of ROS, which in turn stimulates the body's antioxidant defense mechanisms, such as the synthesis of SOD. Using deep breathing methods while practicing yoga may also improve circulation and oxygenation, which may assist to lessen oxidative stress.[2,3]

In order to improve overall health and wellbeing, yoga is a holistic discipline that includes breathing exercises, meditation, and mindfulness techniques. It has been used for thousands of years in India, and in recent years, it has become much more well-liked in the West. Yoga is well known for its potential to improve balance, flexibility, strength, and posture, but it also offers a number of psychological benefits, including the power to reduce stress and anxiety and improve mood.[4] Yoga has also been shown to help a number of medical conditions, such as diabetes, cardiovascular disease, and chronic pain.[5]

Yoga's ability to bolster the body's antioxidant defense system has drawn the attention of researchers. Antioxidants are crucial components of human health because they assist in protecting against the negative effects of free radicals, which can destroy cells and contribute to the onset of chronic diseases. Yoga may increase antioxidant enzyme concentrations in the body, according to numerous research. Reactive oxygen species (ROS) are produced in excess compared to the body's capacity to detoxify them, a condition known as oxidative stress.[2,5] Antioxidants are compounds that aid in protecting the body from this condition. Numerous health issues, such as cancer, cardiovascular disease, and neurodegenerative disorders have been linked to oxidative stress.[4,5]

This literature review seeks to offer a thorough overview of the potential influence of yoga on antioxidant levels and identify any gaps or limitations in the current research by combining the results from various studies.

METHODS

To identify relevant studies, a comprehensive search was conducted using electronic databases, including PubMed, Scopus, and Web of Science. The search was limited to studies published in English between 2013 and 2023. The following keywords were used in various combinations: "yoga," "exercise," "antioxidant," "superoxide dismutase," and "adult." In addition to electronic searches, reference lists of relevant articles were also reviewed to identify additional studies.

Studies were included if they met the following criteria: (1) randomized controlled trials, quasi-experimental, pre-post intervention or case-control studies, (2) involved yoga as an intervention, (3) included adult participants aged 18 years and older, (4) measured SOD levels before and after yoga intervention or compared SOD levels in yoga practitioners with non-practitioners, (5) published in English between 2013 and 2023. Studies that did not meet these criteria, were not peer-reviewed, or were duplicates were excluded. After excluding 450 research articles, a total of 4 studies were included in this review.

RESULTS

455 articles were found from the search strategy. After reviewing the articles, 451 research articles were excluded, a total of 4 studies were included in this review.

Table 1. Summary of the result

Author and year of publication	Sample	Intervention	Result	Conclusion
Ha et al. (2015)[6]	20 females in their twenties with shoulder pain	Hatha yoga	Hatha yoga exercise training resulted in a significant	Regular and continuous modified Hatha yoga exercise would effectively

			increase in plasma SOD activity (p <0.05).	increase plasma SOD activity in female patients with shoulder pain.
Pal et al. (2015)[7]	64 physically male volunteers	Yoga group (yogasana, pranayama, meditation) vs control group (physical activity)	SOD activity increased significantly (p<0.001) in yoga group	Yoga has the beneficial role to decrease oxidative stress by improving enzymatic defense mechanism and nonenzymatic antioxidants. It also maintains antioxidant and redox status.
Bhattacharya et al. (2017)[8]	50 subjects of age group 18-20 years	Treadmill exercise and yoga	SOD levels before exercise in Groups A and B were both (11.56±1.0), and after exercise, Groups A and B were both (12.01±1.09) and (13.31±0.9).	Yoga has a greater positive impact than running on a treadmill, which lowers the formation of free radicals.
Manna et al. (2018)[9]	60 (n = 60) healthy male volunteers within the age group of 18–24 years were included.	Yoga	Malondialdehyde and the proportion of body fat both significantly decreased (P <0.001), whereas superoxide dismutase significantly increased (P <0.001).	Yoga practice on a regular basis lowers oxidative stress and body fat.

Several studies have investigated the effects of yoga on antioxidant levels, particularly superoxide dismutase (SOD), in adults. Ha et al. (2015) found that hatha yoga exercise training resulted in a significant increase in plasma SOD activity (p <0.05) in female with shoulder pain.[6] Click or tap here to enter text.Pal et al. (2015) also reported increased SOD activity (p<0.001) in yoga group compared with control group with physical activity in physically active male.[7] Bhattacharya et al. (2017) reported that yoga had a more beneficial effect than treadmill exercise in decreasing free radical production.[8] Manna et al. (2018) demonstrated that regular yoga practice reduced body fat and oxidative stress, with a significant elevation in SOD.[9] Overall, the studies suggest that regular yoga practice may improve or maintain antioxidant levels in adults.

DISCUSSION

Study by Ha et al. (2015) showed amongst female with shoulder pain, after enrolling for 16-week of hatha yoga exercise program, the yoga group had significantly lower plasma malondialdehyde (MDA) concentrations than the control group. In addition, the yoga group also had significantly higher plasma SOD activity than the control group. The outcome is consistent with a prior investigation that demonstrated a rise in antioxidant enzyme activity subsequent to physical activity. These findings are consistent with previous research wherein a low-energy yoga regimen was found to enhance antioxidant capacity. The majority of research, in instance, showed that the yoga intervention markedly raised SOD levels, whereas a smaller number discovered no significant changes or contradictory results.[11] The results may not be as generalizable, though, as there were only 20 individuals in the study. The yoga group was not randomly assigned to participants, which could have influenced the findings. The effects of yoga on glutathione and overall antioxidant status were not compared to those of other therapies, including physical activity or medicine. This limits our ability to compare yoga to other interventions in terms of how well these outcomes are improved.[6]

Pal et al. (2015) showed that reduced glutathione, vitamin C, and vitamin E; the ratio of reduced to oxidized glutathione; and total antioxidant status were increased significantly in yoga group compared to control group (doing physical activity) in physically trained male. The impact of vitamin C and vitamin E on the human body is significant. These vitamins act as powerful chain-breaking antioxidants during lipid peroxidation by intercepting lipid peroxyl radicals and generating the vitamin E radical as a byproduct. Vitamin C facilitates the production of vitamin E through the acceptance of an electron from the vitamin E radical. This process results in the formation of the vitamin C radical, which can either be excreted in urine or regenerated back to vitamin C through electron donation from reduced glutathione. According to the report, vitamin E and C have the ability to eliminate superoxide radical and hydroxyl radical in lipid and aqueous phase, respectively. This process effectively prevents lipid peroxidation and oxidative damage to other macromolecules. The study found a significant increase in vitamin C and vitamin E levels among participants in the yoga group, without any alteration to their dietary habits. This phenomenon could potentially be attributed to a rise in overall antioxidant capacity or a shift in the participants' inclination towards decreasing redox status. Yoga also has been found to have a positive impact on the body's relaxation response, as evidenced by a reduction in both VO2 and REE.[7]

Bhattacharya et al. (2017) found that yoga and treadmill exercise were also observed to raise SOD levels in young, healthy persons.[8] The rise in SOD levels between the treadmill exercise and yoga groups did not, however, differ significantly. These findings imply that antioxidant defense systems in the body may benefit from both exercise and yoga. However, the fact that there were only 50 participants in the study may restrict how far the results may be applied. It may not be possible to assess the long-term effects of exercise or yoga on superoxide dismutase (SOD) levels because the study was only 4 weeks long. This study's limitation is that it did not compare the effects of yoga and treadmill exercise on SOD levels. This restricts our ability to compare the impacts of yoga and exercise on SOD levels.

Manna et al. (2018) found that after 12 weeks, as compared to the baseline data (0 week), the yoga group showed significant reductions ($P < 0.001$) in the percentage of body fat and malondialdehyde; significant increases ($P < 0.001$) in superoxide dismutase, catalase, reduced glutathione, and ascorbic acid levels.[9] After 12 weeks, however, there was no discernible difference between the yoga group and the control group in terms of height, weight, body mass index, body surface area, or lean body mass. Yoga training may be to blame for these modifications. Only men participated in the study, which may have limited how broadly the results can be applied to populations of women or those with other characteristics. Additionally, this study did not compare how yoga affected body composition and oxidant-antioxidant status compared to other interventions like exercise or medication.

When the body's antioxidant defenses are overpowered by the formation of ROS, unstable chemicals that can harm cells and tissues, oxidative stress takes place. Compounds known as antioxidants have the ability to scavenge ROS and defend against oxidative damage. Superoxide radicals, a subset of ROS, are changed by the crucial antioxidant enzyme SOD into oxygen and hydrogen peroxide, which are less damaging to cells.[10,11] Numerous theories exist regarding how practicing yoga may impact

antioxidant levels, particularly SOD. Yoga's physical asanas could, for example, encourage the creation of ROS, which in turn stimulates the body's antioxidant defense mechanisms, such as the generation of SOD.[4] Hormesis is the term for this process, which is believed to be a major mechanism underpinning the positive effects of exercise on health. This theory states that the body's antioxidant defense mechanisms may be activated by the ROS produced during yoga practice, increasing levels of SOD.[12] The deep breathing exercises employed in yoga practice may also improve circulation and oxygenation, which could aid in lowering oxidative stress. Ujjayi breathing and other deep breathing exercises used in yoga entail taking slow, deep breaths that increase the amount of oxygen in the blood and encourage calm.[13] This improved relaxation and increased oxygenation may aid in lowering oxidative stress and enhancing antioxidant status. Additionally, it's possible that yoga's psychological advantages—such as lower stress and improved mood—could have an indirect effect on antioxidant levels by lowering oxidative stress. Reducing stress through yoga practice may boost antioxidant levels because chronic stress has been associated with increased oxidative stress and lower antioxidant status.[9,14–16]

The majority of the research in the examined studies have small sample sizes, which may restrict the generalizability of their findings and represent the studies' overall shortcomings. We are also limited in our capacity to assess the effectiveness of yoga in enhancing antioxidant status in comparison to other interventions because many studies did not compare the effects of yoga with other interventions, such as exercise or medicine. The longest study only lasted 12 weeks, which may not be long enough to see the long-term effects of yoga practice on antioxidant levels. In addition, the majority of studies only examined short-term impacts. Studies examining the impact of yoga on other populations, such as women or those with certain medical issues, are particularly lacking.

CONCLUSION

In conclusion, a growing body of research indicates that regular yoga practice may raise antioxidant levels in adults, particularly SOD. The stimulation of ROS production by physical postures and the improvement of oxygenation and circulation by deep breathing techniques are some of the proposed mechanisms underpinning this effect. According to these results, yoga may have anti-aging properties and may even lower your risk of developing chronic diseases linked to oxidative stress.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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