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Effects of yoga on physical and physiological variables: A narrative review

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Abstract
This report summarizes the current evidence on the effects of yoga interventions on various components of physical and physiological health, by focusing on the evidence described in specified articles. The purpose of this article is to review this research systematically and determine if regular yoga training improves certain physical and physiological variables. Collectively, these reviews suggest many areas where yoga may be beneficial, but more research is required for virtually all of them to establish such benefits. The variety of the circumstances and therapies under study has made meta-analysis a less useful tool for compiling the body of recent research. Nevertheless, some meta-analyses indicate the beneficial effects of yoga interventions, and there are several randomized clinical trials (RCT's) of relatively high quality indicating the beneficial effects of yoga for physical and physiological health. Yoga may be effective as a supportive adjunct to mitigate some medical conditions, but not yet a proven stand-alone, curative treatment. It is highly recommended that larger, more thorough studies with better methodological quality and sufficient control interventions be conducted because yoga may be a helpful, supportive, and reasonably priced adjunct treatment. It can also be practiced as a kind of self-care behavioral treatment. It gives practitioners a lifelong behavioral skill that improves self-efficacy and self-confidence and is frequently linked to other positive side effects.

Keywords: Yoga, physical, physiological, intervention

1. Introduction
Yoga's intellectual foundations are rooted in ancient Indian philosophy. Many schools or varieties of yoga exist today (e.g., Iyengar, Viniyoga, Sivananda, etc.), each with a unique focus on the proportion of physical exercises and postures (Asanas), breathing exercises (Pranayama), deep relaxation, and meditation techniques that develop awareness and eventually reach deeper states of consciousness. The application of yoga as a therapeutic intervention, which began early in the twentieth century, takes advantage of the various psychophysiological benefits of the component practices. The physical exercises (*Asanas*) may increase one's physical flexibility, coordination, and strength, while breathing practices and meditation may calm and focus the mind to develop greater awareness and diminish anxiety and thus result in a higher quality of life. Other beneficial effects might involve a reduction of distress, and blood pressure, and improvements in resilience, mood, and metabolic regulation. Even though the number of clinical research studies and despite several comprehensive assessments of yoga's therapeutic benefits, there is currently insufficient proof to support the practice's clinical applicability for a wide range of symptoms and illnesses. There is conflicting evidence for many particular indications and diseases; whereas some studies find that yoga therapies have a good impact, other studies are less definitive. Certain variations in the study populations (e.g., age, gender, and health status), the specifics of the yoga interventions, and the follow-up rates may occasionally be the cause of these disparities. The current research on the therapeutic benefits of yoga interventions on several aspects of mental and physical health is compiled in this study. (Khalsa, 2004) [5] in his studies stated that a majority of the research on yoga as a therapeutic intervention was conducted in India and a significant fraction of these were published in Indian journals. In their bibliometric analysis from 2004, they found that 48% of the enrolled studies were uncontrolled, while 40% were randomized clinical trials (RCT), and 12% were non-RCT (N-RCT). The main categories which were addressed were psychiatric, cardiovascular, and respiratory disorders.

A heterogeneous collection of studies with varying effect sizes, heterogeneous diagnoses, and heterogeneous outcome variables are generally included in the corresponding review, along with small sample sizes, frequently limited methodological quality, varying control interventions, various yoga styles, and significantly divergent intervention durations.

2. Yoga and Physical Health

2.1 Physical Fitness

There was one experimental study that evaluated whether yoga can engender fitness in young females. The study aimed to investigate the effect of yoga on Cardio-Respiratory endurance, Body Composition, Flexibility, and Muscular strength of females between the age group 18-25 years. (Bedekar & Hande, 2017) [1] in their study found that there was a significant increase in cardio respiratory endurance (p = 0.0001), body composition (p= 0.0001), flexibility (p = 0.0001) and muscular strength (p= 0.0001) after undergoing four weeks of yoga when compared to that before yoga. The data obtained was analysed using paired 't' test. $p<0.0001$ was the level of significance.

(Kumaravelu & Jayachandran, 2021) [7] Investigated the effect of 12 weeks of strength training on abdominal strength, explosive power, aerobic endurance and lower back and hamstring flexibility of school children. The results showed that Yoga in long duration affects hypothalamus and brings about decrease in the systolic and diastolic BP through its influence on vasomotor centre, which leads to reduction in sympathetic tone and peripheral resistance. The relaxation and exercise components of yoga have a major role to play in the treatment and prevention of high blood pressure (hypertension) and body composition. There are many poses in Yoga that can improve the health of the heart by improving blood circulation. They also help in the removal of toxic waste from the body and regulate the hormones to keep us healthy (Odunaiya *et al*., 2005) [8].

(Corbin & Noble, 1980) [3] determined the impact of general program of yoga on the muscle fitness, body composition and metabolic risk factors in middle age women with overweight where Muscle endurance and flexibility, fat percentage, body mass index, blood glucose and lipids levels were obtained, before and after 8 weeks of yoga practice. Data indicated significant increase in muscle endurance (p = 0.012) and flexibility (p = 0.049) occurred in yoga group. Significantly decrease in Body Mass Index and body fat percentage was observed ($p\leq0.0001$).

2.2 Cardiovascular Endurance

(Raub, 2002) [11] included 7 controlled studies, reported "significant improvements in overall cardiovascular endurance of young subjects who were given varying periods of yoga training (months to years)". During exercise testing, outcome measures included blood lactate, anaerobic threshold, oxygen consumption, and work output. As predicted, compared to other kinds of exercise, physical fitness increased in teens or young adults (athletes and untrained individuals), with longer yoga practise leading to better cardiopulmonary endurance.

2.3 Sympathetic/Parasympathetic Activation.

(Innes *et al*., 2005) [4] conducted a systematic review of published literature regarding the effects of yoga, a promising mind-body therapy, on specific anthropometric and physiologic indices of cardiovascular disease (CVD) risk and on related clinical endpoints. The effects of yoga on cardiovagal function and sympathetic/parasympathetic activation have been the subject of 42 investigations, comprising 9 randomised controlled trials, 16 non-RCTs, 15 uncontrolled trials, and 2 cross-sectional trials. "There is some evidence that yoga causes a shift in autonomic nerve system balance from predominantly sympathetic to parasympathetic, a reduction in sympathetic activation, and augmentation of cardiovagal function," according to the majority of research.

3. Yoga and Physiological Health

3.1 Blood pressure and Hypertension

(Innes *et al*., 2005) [4] reported on 37 studies investigating the effects of yoga on blood pressure and hypertension, among them 12 RCTs, 12 nonrandomized clinical trials, 11 uncontrolled studies, 1 cross-sectional study, and 1 single yoga session examination. The majority reported a decrease in either the diastolic or systolic pressure. It is, however, "difficult to discern an impact specific to yoga" due to a number of identified possible biases in the analysed research (Such as confounding by lifestyle or other factors) and limitations in some of the investigations.

(Ospina *et al*., 2007) [9] in their reports cites two studies which found small, insignificant improvements of systolic (weighted mean difference = −8.10; 95% CI, −16.94 to 0.74) and diastolic blood pressure (Weighted mean difference = −6.09; 95% CI, −16.83 to 4.64) in favour of yoga when compared to no treatment. Yoga interventions only slightly and insignificantly improved systolic blood pressure (Weighted mean difference = −15.32; 95 percent confidence interval, −38.77 to 8.14) and diastolic blood pressure (Weighted mean difference = −11.35; 95 percent confidence interval, −30.17 to 7.47) in comparison to health education.

3.2. Pulmonary Function

(Raub, 2002) [11] examined studies evaluating yoga's effects on lung function in healthy volunteers and patients with chronic bronchitis and asthma. Yoga practitioners who are in good health have shown improvements in a number of lung function parameters when they practise breathing control, particular postures, and/or relaxation techniques. The length of the yoga training, the style of yoga practise (such as breathing exercises and yoga postures), and the topic matter all affected these gains, which were "not constant."

(Singh *et al*., 1990) [13] studies on patients with asthma describing improvements in peak expiratory flow rate, medication use and asthma attack frequency. Lung function measures showed only a few minor and non-significant improvements in a double-blind, placebo-controlled RCT. Therefore, more thorough studies are required to determine the benefits of yoga breathing techniques for asthmatic patients.

3.3. Vital Capacity

(Knowles & Hamilton, 2003) [6] studied the effects of yoga poses and breathing exercises on vital capacity in a healthy middle-aged man. It was found that the subject's vital capacity increased from 3.93 litres to 4.43 litres, a net gain of 0.5 litres or 9%. Changes in thoracic expansion and flexibility measures were as follows: circumference of axilla: +7/12 inches; circumference at xiphoid process: +1/4 inch; circumference midway between xiphoid process and navel; +1/3 inch; forward bending: +1/3 inch; side bending left: -1/3 inch. Side bending right was unchanged. The study indicates vital capacity may be increased utilizing yoga.

(Birkel & Edgren, 2000) [2] studied the effects of yoga

postures and breathing exercises on vital capacity. A total of 287 college students, 89 men and 198 women were taken as subjects. Vital capacity determinants were taken near the beginning and end of two 17-week semesters. Subjects were taught yoga poses, breathing techniques, and relaxation in two 50-minute class meetings for 15 weeks. The study showed a statistically significant (p<.001) improvement in vital capacity across all categories over time.

3.4. Respiratory Function

(Santaella *et al*., 2011) [12] in their study concluded that Yoga respiratory training improves respiratory function and cardiac sympathovagal balance in elderly subjects. 76 healthy elderly subjects were enrolled in a randomised control trial in Brazil and 29 completed the study (age 68±6 years, 34% males, body mass index 25±3 kg/m^2). Yoga respiratory exercises (Bhastrika) consisted of rapid forced expirations followed by inspiration through the right nostril, inspiratory apnoea with generation of intrathoracic negative pressure, and expiration through the left nostril. At baseline and four months later, pulmonary function, maximal expiratory and inspiratory pressures (PEmax and PImax, respectively), heart rate variability, and blood pressure variability were assessed for the purpose of determining spontaneous baroreflex. In the control group, physiological indicators remained unchanged after four months. However, the low frequency component (a marker of cardiac sympathetic modulation) and low frequency/high frequency ratio (a marker of sympathovagal balance) of heart rate variability (40 percent, p<0.001) were significantly lower in the yoga group, as were PEmax (34 percent, p<0.0001) and PImax (26 percent, p<0.0001).

(Parikh *et al*., 2014) [10] studied effect of yoga practices on respiratory parameters in healthy young adults. The study group consisted of 30 young adults (19 males and 11 females). Participants had a mean± SD age of 17.81±0.48 years, height of 164.21±5.09 cm and weight of 54.34±5.63 kg. All of the pulmonary parameters were shown to have increased statistically significantly in the regular yoga practitioners. According to this study, doing yoga on a daily basis can enhance general wellbeing and physical fitness.

4. Discussions

While these reviews point to several potential benefits of yoga, further study is needed to confirm benefits for almost all of them. This, however, is not surprising considering the small number of research studies that have been done on yoga as a therapeutic intervention during the last four decades. Individual investigations into yoga's potential benefits for different diseases are typically brief, subpar studies with several opportunities for bias. Furthermore, a great deal of variation exists in the populations that have been researched, yoga therapies, the frequency and duration of yoga practise, comparison groups, and outcome measures for various illnesses (e.g., depression and pain). It is difficult to separate out the consequences of this variation in order to comprehend the usefulness of yoga therapies in different situations. Heterogeneity and low quality of the original trials suggested that meta-analyses could not be performed properly for many conditions. It is advised to conduct more research in this field, especially given the credibility of the underlying psychophysiological explanation (which includes the benefits of regular exercise, deep breathing exercises, physical and mental relaxation, a balanced diet, etc.).

Yoga may be helpful for those with pain, with overall moderate effect sizes, while it is not surprising that training might increase physical fitness through either yoga or other exercises. The positive effects could be attributed to improved mood, reduced distress, enhanced physical flexibility, mental focus and calmness to raise awareness and decrease anxiety, and so on. Patients may sense greater self-competence and self-awareness as a result of realising that they can engage in physical activity even in the face of ongoing pain sensations, which enhances their quality of life. It is possible that asanas in particular improve physical flexibility and fitness with a secondary benefit to mental health, whilst pranayama exercises and relaxation/meditation techniques may lead to increased awareness, reduced stress, and an improved quality of life. Future research that is conducted correctly will still need to demonstrate this, though.

Yoga therapies may well boost self-efficacy and confidence since patients practise yoga as a self-care behavioural treatment. Adherence may be a critical factor that restricts the potentially positive effects of yoga, as yoga intervention programmes obviously involve the active engagement of the individuals, as do any behavioural therapies.

Thus, more research is needed to determine which patients would benefit from the yoga interventions, which aspects of the yoga interventions—such as physical activity, meditation, and subsequent lifestyle modification—were most effective, and which particular yoga styles were less effective than others. More thorough and extensive research is strongly encouraged because yoga has the potential to be used as a helpful and safe supportive/adjunct therapy that is also reasonably priced, can be practised as a self-care behavioural therapy, imparts lifelong behavioural skills, boosts self-efficacy and self-confidence, and is frequently linked to other positive side effects. (Table 1)

Particular Impact Non-Particular Impact
Cognition Self Efficacy; Beliefs, Expectations; Mindfulness Control of attentional network
Emotions Emotional Regulation Quality of Life
Physiology Heart Rate, Respiratory rate, Stress Reduction Social Contacts
Physical Body Flexibility, Endurance Healthy Life Style

All things considered, a number of evaluations point to the potential health advantages of yoga, but the generalizability of these encouraging study results is constrained by a number of methodological flaws, such as small sample numbers and heterogeneity in the controls and interventions. As a supporting supplement to treat medical disorders, yoga may be beneficial in enhancing patients' self-efficacy, self-competence, physical fitness, and social support. However, it is not yet a proven curative treatment on its own. It is necessary to conduct confirmatory studies with better methodological quality and sufficient control interventions.

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