REPORT ON

# Engineering Health: Introduction to Yoga and Physiology

Course from

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Submitted by


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Registration number:

12013985


*In partial fulfillment for the requirements of the award of the degree of*

## B.Tech CSE (P132)


LOVELY PROFESSIONAL UNIVERSITY

School of Computer Science and Engineering,
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# *Declaration*

I **Rakshit Singh Tomar**, Registration number: **12013985**, hereby declare that the work done by me on **"Engineering Health: Introduction to Yoga and Physiology"** from **June, 2021** to **July, 2022** is a record of original work for the partial fulfillment of the requirements for the award of the degree, **B. Tech CSE (P132)**.

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**Note:* *The published papers/publications that are either cited or referenced in the report have received proper credits in the* ***References*** *section.*

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# *Acknowledgement*

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I am thankful to my parents for their constant support and encouragement. Thanks to my friend, who inspires me every day.

Signed by Rakshit Singh Tomar (12013985)

# Contents



(*Citations from the articles published in some journals as per specified standards)

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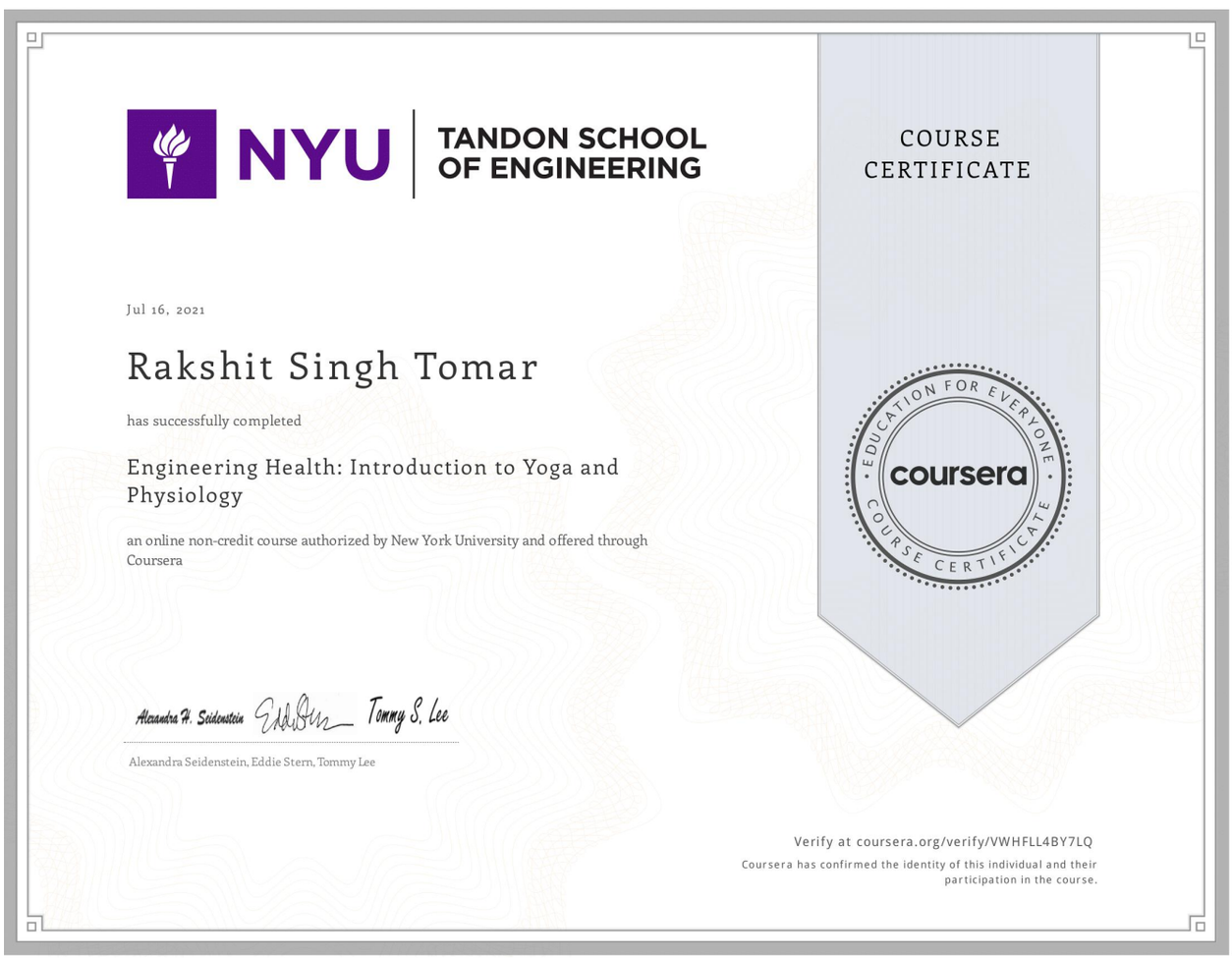

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Engineering Health: Introduction to Yoga and Physiology

# 1

# Introduction

Yoga can be defined as a psycho-somatic-spiritual discipline. To put it simply, yoga is a discipline that aims at creating a balance between the mind, and the body. Yoga consists of a wide range of activities that primarily includes breath control, mindfulness, and physical exercises. Further, this can be classified into asanas (physical exercise), pranayama (conscious breathing), and dharana (concentration).

The physiology of yoga deals with the effects of yoga on various human body systems in stimulating and aiding their functionality either directly or indirectly. Studies have shown practicing yoga on regular basis can have considerable health benefits, which include improved cognitive abilities, reduced risk of cardiovascular diseases, management of diabetes, improved body mass index (BMI), improved blood pressure, and hormonal balance, sooner or later.

## Identifying the Problem

Stress has become the part and parcel of our lives. Although having mild stress may not lead to any serious health problems. The problem comes with sustained levels of stress, and an unhealthy lifestyle, which can increase the risk of serious health problems like obesity, hypertension, heart diseases, depression, and the list continues. Adding to it, we as students are constantly exposed to many stressors, which may include academic pressure, competitive pressure, personal issues, and social anxiety. This can not only hamper our efficiency but also potentially lead to serious health conditions. Moreover, the COVID19 outbreak has helped us realize and re-evaluate the importance of health in our lives.

Integrating yoga into our daily lives can help us achieve a state of physical and mental well-being.

## Objectives

- To study the physiological effects of yoga on major human body systems, which include the nervous, cardiovascular, respiratory, lymphatic, immune, musculoskeletal, renal, digestive, endocrine, and reproductive systems of the body.
- To identify the role of yoga in cell homeostasis.
- To identify the role of yoga in the field of epigenetics.
- To highlight the effectiveness of yoga and physiology from the findings of research-based studies concerned with the physiological effects of yoga.
- To highlight a few yoga poses that may help us by aiding functionality of major human body systems, management, and prevention of lifestyle disorders.

## Effectiveness—Featuring Research Studies

The physiological effects of yoga can be examined by the studies conducted in this domain. The findings along with the objectives of a few such studies are summarized below:

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**Citations to all the papers cited/referenced in this section of the report are mentioned in the references section (APA style).*

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- A study conducted by Kumar et al. (2020) to determine the effect of yoga on the autonomic nervous system showed that 30 subjects between 20-40 years of age with at least five years of yoga practice had better resting heart rate, resting diastolic, and handgrip systolic blood pressure compared to another group of 30 subjects between 20-40 years of age with no such regular exercise or yoga.
- A study conducted by Sahni et al. (2021) on a total of 668 adults subjected to yoga showed low levels of depression and anxiety during COVID19 lockdown.

- Chaya et al. (2012) conducted a study on a group of children aged between 7-9 years from the same school. The 200 subjects were divided into two groups. The first group was subjected to yoga or physical activity and the second group was with no such activity. After three months of intervention and three months post-intervention, both the first group (yoga control group) and the second group were tested for Wechsler Intelligence Scale. The first group showed signs of improved cognitive abilities in comparison to the second group.

- A study was conducted by Chimkode et al. (2015) on 30 male patients aged between 36-55 with type II diabetes and 30 male non-diabetic volunteers. Both the groups were subjected to yoga practice for over six months. The results showed that the blood-sugar levels of the diabetic group decreased significantly.

- A study conducted by Dhananjai et al. (2013) on a total of 272 obese subjects that were divided into two groups. Group 1 consisted of 205 subjects that were subjected to yoga and group 2 consisted of 67 subjects that were subjected to only aerobic exercises. Neither of the two groups was subjected to diet restriction. The results for both groups were comparable. Although group 1 showed more decreased levels of depression than group 2, which showed that yoga can be an effective treatment in treating depression, particularly associated with obesity.

- Pandey et al. (2017) conducted a study on a total of 50 patients suffering from chronic kidney disease (CKD). They were divided into two groups. The first group with 25 subjects was subjected to yoga therapy along with conventional treatment while the second group with 25 subjects was only subjected to conventional treatment. After 6 months of intervention, the yoga group showed a significant reduction in blood urea levels and overall kidney functionality compared to the second group.

# 2

# Yoga and Cell-Homeostasis

Our body needs to be in a steady state, reacting to the environment also known as homeostasis. Here the steady-state refers to the state of things like temperature, blood pressure, cardiac output, levels of oxygen and carbon dioxide the amount of food storage or glucose versus lipid storage, immune system reaction, pH, the bacterial environment, and the microbiome. To maintain a steady state requires so much energy, so much time and so many resources. We need to decrease both physiological stress and molecular stress in terms of toxins, UV light, and free radicals. And need to create the healthiest proteins for the healthiest functioning of our cells and the cell signaling.

Yoga can promote healthy signaling and lead to healthy pathways by decreasing stress and promoting overall cell health. It stimulates healthy cell production. This can be achieved with not only yoga but by eating healthy, by decreasing unhealthy thoughts of stress, consistency of sleep patterns, and positive thinking.

Cells require protein development. Yoga can aid proper protein development by aiding processes like the absorption of vitamins and co-factors that are responsible for protein development. Practicing yoga regularly can significantly improve cell development, signaling, and overall functioning.

3

# Genetics and Epigenetics: The Role of Yoga

## Yoga and Genetics

Some studies have recently shown that moderate exercise, decreasing stress, yoga, and mindfulness can help keep our telomeres long. The shortening of telomeres can have a systemic effect as it will start to interfere with genes that we need to make proteins. In addition, the shortening will continue over rounds of replication and time and this can eventually lead to cell death. There is an enzyme called the telomerase which helps to lengthen them or keep them long through all of our replication processes although a lot of cancer is associated with telomeres that are very long as it helps to promote cells lasting but in the case of cancer it can increase the life of cancerous cells. So we need to keep a balance between the number of free radicals, the shortening of telomeres, and promoting health and wellness by reducing stress as stress can potentially decree the telomeres. This balance can be achieved by developing a regular yoga practice.

## Epigenetics and the Role of Yoga

Epigenetics focuses on dynamic aspects of genetics. Epigenetics means sticking to genes. These are tiny molecules attached either directly to the genes or the histones. These tiny molecules are methyl groups. Although all cells have the same genes, their gene expression patterns differ. Genes must be boosted or downregulated in various instances. These microscopic groupings control which parts of our DNA or genetic information are to be translated.

These methyl patterns actually can change from life events, they can change from the diet, they can change from exercise, they can change from stress, they can change from trauma. So committing to a healthy lifestyle by practicing yoga regularly, optimizing the levels of stress and good nutrition can have a positive impact on these epigenetic markers.

The repetition of healthy life choices like yoga can mark a fair effect on epigenetic markers over time which can help our bodies to deal and manage chronic stress, chronic pain, and over the simulation of the sympathetic nervous system (responsible for increased heart rate, blood pressure and variety of factors forming a basis of our body's stress response), which are based on feedback loops. These feedback loops often decide how the body should react to certain situations in a certain way.

# 4

# Yoga and the Nervous System

Our body neither renews neurons nor replenishes the dead neurons, so it becomes important to ensure that the existing ones stay healthy. This can be achieved by creating new connections by strengthening certain connections by adding actual synapses. For example, if we have been stressed out for a long time, we may have more elaborate connections between neurons regarding the sympathetic nervous system. This would require us to increase the connections with the parasympathetic nervous system. This can be achieved by synaptic plasticity, which is the ability to make new connections through repeated behavior.

Yoga can aid Yoga can aid synaptic plasticity change. Yoga can help by increasing connections between the neurons that are involved in the activation of the parasympathetic nervous system. At the same time, calming down the sympathetic nervous system, whose over-stimulation may lead to a variety of health problems. The Vagus nerve can help with the making of elaborate connections with the parasympathetic nervous system. The parasympathetic nervous system can be regulated by the vagus nerve and the tenth cranial nerve. Therefore, it plays a crucial role in controlling the heart rate, digestion, and pulmonary functions. As the vagus nerve can regulate breath and heart rate and decrease over activation and stress. The vagus nerve activation can be achieved by yoga.

Yoga can boost levels of the feel-good brain neurotransmitters like GABA, dopamine, and serotonin, which are also responsible for feelings of relaxation and contentedness.

## Yoga Pose: To Aid Parasympathetic Activation

**Balasana (Child's Pose)**

- To start with, sit on your knees keeping your feet together such that the hips rest on your heels. The knees should be separated about the width of your hips. Now, place your hands on your thighs, resting your palms down.
- Deeply inhale, and then exhale while bringing your arms forward such that your chest is between your knees.

- Only if possible, stretch out your arms resting your forehead on the floor. The arms need to be on the sides with palms up such that the hands are resting on either side of your feet.
- Breath consciously through your nostrils continuing to be in the posture. Try to hold for 2-3 minutes. Following this, return to upright kneeling posture keeping your back straight and hands on your thighs.
- Repeat this entire pose to at least form 2-3 repetitions.

5

# Yoga, the Respiratory and Cardiovascular Systems

In yoga, breathing exercises like alternate nostril breathing can have a great impact on the respiratory system as the posture is optimized to fill the lungs. In alternate nostril breathing, we manipulate our flow of respiration. Also, these exercises can lower stress as stress can cause us to hold our breath or to breathe very quickly, and shallow quick breathing can be detrimental to oxygen flowing to our tissues. A study shows yoga can have a significant impact on asthma by decreasing day-night asthma attacks, reducing drug intervention for asthma, and improving the peak expiratory flow rate (maximum amount of air that one can expel or push out of our lungs beyond our normal breathing).

So some of the things that yoga had been proven over and over again to help with are decreasing stress, improved cardio-respiratory performance increasing overall circulation of the blood. Few studies suggest that yoga can modify and decrease blood pressure.

## Yoga Pose: To Support Respiratory System's Function

**Anulom-Vilom Pranayama (Alternate Nostril Breathing)**

- Keeping your legs crossed sit in a comfortable position.
- Then place your left hand on the left knee.
- Now, lift your right hand towards your nose.
- Using the right thumb to close our right nostril exhale completely.

- Following this, close the left nostril with your fingers and inhale slowly and deeply.

- Exhale opening the right nostril.
- After inhaling through the right nostril, close this side of your nostril with your fingers.
- Exhaling through the left side opening the left nostril.
- This comprises one complete cycle.
- Continue for up to 5 minutes.
- This practice should always be completed with an exhale from the left nostril.

6

# Yoga, the Lymphatic and Immune Systems

Yoga can put pressure on the lymphatic vessels, thereby aiding flow and better drainage by decreasing stress and reducing inflammation. Vinyasa flow sequences such as Surya namaskar keep the whole body in constant motion providing movement to major muscle groups. Pranayama can increase oxygen flow through the up and down motion of the diaphragm facilitating the movement of the lymph in that area.

Yoga benefits the immune system by reducing inflammation associated with some chronic conditions. Sustained levels of chronic stress may be linked with auto-immune diseases. Yoga can decrease stress and optimize our immune system that would keep diseases at bay.

## Yoga Pose: For the Lymph

**Adho Mukha Svanasana (Downward Facing Dog)**

- Begin with getting in all fours position such that your hips are above your knees and shoulders above your wrists.
- Now, bring your hands forward such that your hands are slightly ahead of your shoulder and spread your finger with the middle finger pointing forward.
- The next step assumes the position of Hasta Banda, where a suction-like cup is created with the base of your palm pressing through the outer edges of the palm and fingertips slightly against the floor.

- Now, roll your upper arms away and your forearms spiral inwards such that a spiral action is created in your arms.
- On exhalation, engage your lower belly drawing the navel back to the spine. Now, press through your hands lifting your hips back and holding them up into an upside-down V pose.
- Lengthen your spine keeping your knees bent at first.
- Relax your neck by sliding the shoulder blades down along the spine, collar bones spread.

- To advance in this position, lengthen your spine by bending and straightening your legs and bringing both heels towards the floor such that the heels do not touch the floor.
- Try to stay in this position for five breaths.
- Bring your knees back down to the floor and assume Balasana in this transition by stepping one foot towards your hands, to come out of the pose.

7

# Yoga and the Musculoskeletal System

Yoga improves strength and musculoskeletal coordination. Certain yoga asanas that are isometric can provide optimal tension in the muscles, which strengthens and stabilizes the muscles. A series of asanas involve a counterpose, which can increase steadiness, flexibility, endurance, anaerobic power, and better neuro-muscular coordination. Yoga can improve body posture and aid the release of muscle tension. It lubricates the joints.

Studies suggest that yoga can keep musculoskeletal disorders like multiple sclerosis at bay. Yoga has known to play a significant role in the management of conditions like osteoporosis as yoga can improve bone strength and bone density, thereby reducing the risk of fractures by introducing balance, stability, and improved flexibility that prevents falling.

## Yoga Pose: To Strengthen the Muscles

**Vriksha Asana (Tree Pose)**

- Start with assuming the posture as in Tadasana by spreading your toes, rooted down through your feet and make your legs firm. Now, raise your front hip pointing towards your lower ribs which would create a gentle lift in the lower belly.
- Floating your chest up inhale deeply and exhale as you draw your shoulder blades down your back. Focus on your gazing spot looking straight ahead in a steady manner.

- Raise your right foot up onto your left thigh with your hands on your hips.
- Extend your right thigh as far as possible until your pelvis starts to rotate with the leg.

- After opening the knee, bring back your pelvis such that it assumes a neutral position.
- Once you assume a stable position, stretch your arms overhead just like those branches pointing to the sun overhead.
- Get back to Mountain Pose and repeat the same on the other side.

8

# Yoga, the Renal and Digestive Systems

## Yoga and Kidney Health

Nowadays, kidney-related diseases are becoming more prevalent, which is a combined result of factors such as stress, insufficient nutrition, unhealthy lifestyle choices that lead to renal deterioration. The blood pressure is also regulated by the kidneys as they secrete. When blood pressure is too low, the nephrons and the kidneys control low blood pressure. But if it's too high, it may harm kidney function and in worst cases, it may lead to kidney failure. This is the reason why people who have high blood pressure usually have kidney disease later on in life.

Yoga asanas can help us by reducing stress and calming our parasympathetic nervous system, which brings down blood pressure. Thereby, optimizing blood pressure that can lead to improved kidney health. Besides yoga, measures like drinking sufficient water, sleep and avoiding unhealthy food can improve kidney health.

## Yoga and the Digestive System

The digestive system is prone to many abnormalities and pathologies, which includes eating disorder, some type of ulcers, acid reflux, obesity, IBS (Irritable Bowel Syndrome), and diabetes. Yoga can help with the prevention of some of these abnormalities or pathologies through asanas that involve twisting, stretching, activation of the digestive system, and decreasing our overall stress.

Studies have shown yoga can have a therapeutic role in the management of diabetes by positively affecting blood-glucose levels. It can also help in the management and prevention of type II diabetes by stimulating insulin-producing beta cells. Yoga can aid weight loss and control, which may help with the prevention of type II diabetes to a certain extent.

## Yoga Pose: For Kidney Health

**Ardhamatsyendra Asana (Half Spinal Twist Pose)**

- To begin with, sit down keeping your back erect and your legs stretched out. Place your feet together keeping your spine erect.
- Adjust your left leg such that the heel of the left foot lies next to the right hip. Alternatively, you can keep the left leg stretched out.
- Place the right leg taking it over the knee such that the right leg lies next to the left knee.
- Keeping your spine erect, twist your neck, waist and adjust shoulders towards the right side such that you can see over your right shoulder towards the right.
- Adjust your arms to increase or decrease the stretch. To do it place your right hand behind and the left hand on the right knee.
- With slow and deep breaths try to hold the pose for 30-60 seconds. Release the waist, chest, and right hand and then the neck while exhaling. Relax once you assume the normal sitting position.
- Now, repeat the same steps but on the other side.

9

# Yoga, the Endocrine and Reproductive Systems

## Endocrine System: Overview

Metabolism, growth, mineral balance, heart rate regulation, sleep cycles, and other functions that are regulated by the endocrine system all contribute to homeostasis. The endocrine system, which is responsible for reacting to stress, thoughts, emotions, and other variables, is controlled by the hypothalamus in the brain. The pituitary gland, which generates chemicals to trigger hormones from other endocrine glands, receives signals from the hypothalamus. The pituitary gland is in charge of the endocrine system as a whole. The endocrine system is composed of the adrenal cortex, pituitary gland, hypothalamus, pancreas, thyroid gland, parathyroid glands, testes, and ovaries.

## HPA Axis - Stress and Negative Feedback Loops

The role of the feedback loops is to maintain homeostasis between stress and recovery. The Hypothalamic-Pituitary-Adrenal (HPA) Axis is a pathway that connects the Central Nervous System (CNS) with the endocrine system to regulate the stress response. In the big picture, things like chronic stress can lead to sustained activation of the HPA Axis through negative feedback loops. This can cause a rise in cortisol levels and hormonal imbalance. Sustained high levels of cortisol may lead to Cushing syndrome.

## Yoga and the Endocrine System

Yoga asanas can pressurize and depressurize specific glands of the endocrine system, which can regulate secretions. Yoga can increase oxygenated blood supply to the brain and hypothalamus stimulating it and aiding its overall functionality. Yoga helps in the management of chronic stress that can otherwise affect the functioning of the endocrine system through negative feedback loops and may result in over-stimulation of the sympathetic system. Some studies have shown yoga can help by balancing cortisol levels, increasing pain tolerance, and reducing anxiety.

## Yoga and the Reproductive System

Some yoga asanas can massage and strengthen core muscles around the reproductive organs, massaging the pelvic floor muscles. Yoga asanas can aid hormone production by stimulating the major reproductive organs. Yoga can help us improve our reproductive health by increasing the production of the beta-endorphin hormone from the brain, which relieves pain, enhances immunity, and prevents infections. Yoga asanas can increase oxygen-rich blood supply to reproductive organs. Yoga can increase sperm production in males and boost fertility.

## Yoga Pose: For Hormonal Balance

**Setu Bandha Sarvangasana (Bridge Pose)**

- To start with, lay down in Shavasana such that your knees point towards the ceiling and the soles of your feet lie flat on the floor or the yoga mat. Your hands should be placed at your sides and keep your neck long.
- Keeping your knees aligned with your hips bring your heels up taking a deep breath such that you should be able to touch the soles of your feet with your fingertips.
- On exhale, start lifting your hips to the floor such that your feet press evenly on the floor or the yoga mat. Holding this position try to feel the stretch in your spine. Make sure that the neck should be kept long with toes pointing forward and shoulder on the ground.
- Keep your glutes soft and push your hips bit forward towards your knees. To increase the stretching you can interlock your hands.
- Try to feel the stretch holding the pose for five to ten breaths.
- Resume your normal position slowly with an exhale by lowering your hips to the floor or the yoga mat.

# 10

# Conclusion

> *One of the fundamental principles of yoga: a small action done repeatedly can make an enormous difference.*
>
> *– Dr. Timothy McCall*

In conclusion, dedicating a few minutes from our stressful lives every day to practice yoga can make a big difference out there. It can help to break out from feedback loops of stress and chronic pain. We as students are exposed to many academic stressors, which may affect us in the long run. Integrating yoga into our daily lives can not only help with lifestyle disorders but also stress management, and improved cognitive abilities. Yoga can even mark a change on cellular levels by aiding healthy cell signaling, improving neuro-effector communication, and so on. It can stimulate vital human body systems and aid their functioning at different levels. Yoga can help with the management of lifestyle disorders like obesity, hypertension, cardiovascular diseases, asthma, and diabetes. Many research studies have shown yoga to have therapeutic effects. Yoga need not be a set of physically challenging poses; it can be as simple as mindful and conscious breathing in pranayama or relaxing in Shavasana with slow deep breaths.

The research in the field of yoga is advancing than ever. At the same time, there need to be more conclusive research studies exploring the physiological effects of yoga.

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(Formatting of citations: APA-7 Style)


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