

Original Research Article

“COMPARATIVE STUDY ON THE PHYSIOLOGICAL EFFECT OF YOGA ON BODY MASS INDEX (BMI), STRESS MARKERS AND IMMUNO-ENHANCER/ANTI-AGING HORMONE ALONG WITH PULMONARY FUNCTIONS”

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1. INTRODUCTION:

The term “YOGA” and the English word “YOKE” are derived from Sanskrit root “yuj” which means union. Yoga is a psycho-somatic-spiritual discipline for achieving union and harmony between our mind, body and soul and the ultimate union of our individual consciousness with the Universal consciousness. Yoga is a mind-body technique which involves relaxation, meditation and a set of physical exercises performed in association with breathing. Being holistic, it is the best means for achieving physical, mental, social and spiritual wellbeing of the practitioners. (Madanmohan et al, 2008) ¹

Yoga practice mainly consists of Asana (posture a particular position of the body which contributes to steadiness of body and mind), Pranayama (to control the breathing in a superior and extra-ordinary way to get maximum benefits.) and meditation. It produces consistent physiological changes and has sound scientific basis. Yoga may be attractive as an alternative to traditional aerobics and strength training program because it requires little space and virtually no equipment, limited or no harmful side effects and with its focus on relaxation of mind and body. It provides qualitatively different exercise experience which may be perceived as less strenuous and more pleasurable. It does not cost a money to reduce weight. There are no side effects. Weight loss is accompanied by proper conditioning of body. One can lose weight and feel better also as yoga rejuvenates the body. Yoga helps to bring the mind-body connection. Which can improve self-image and acceptance of your body (Nisha Shinde et al, 2013)².

Regular Yoga can increase musculo-skeletal flexibility, physical stability, strength, and balance, as well as helping participants to enter states of deep relaxation and awareness. Many individuals experience a greater serenity and calmness about life in general, improved

circulation, better muscle tone, and fewer periods of illness. Integrated holistic approach of yoga therapy purifies the body and mind. Yoga can control daily behaviors, produce self-awareness, boost personal growth and bring self-realization. This can help to improve eating patterns and promote self-control. Yoga has a promising effect in addressing a wide range of health conditions by stabilizing BMI.

The tendency of increasing weight or obesity as well as low body weight is being prevalent day-by-day in all aged persons. Various Studies have shown that BMI at low and high level indicate morbidity and mortality. Yoga therapy is beneficial in maintaining good health by regulating BMI. Hence the efficacy of yoga therapy on body weight may have direct impact on its use as a safe therapeutic modality in combating obesity and low BMI (**Ashutosh Chauhan et al, 2017**)³.

Association between abnormal BMI and impaired pulmonary functions has been reported widely, with disparity between males and females. The BMI, Fat%, Muscle mass, Fat free mass, Fat free mass Index, Waist hip ratio have significant association with pulmonary functions. Fat accumulation in thoracic and abdominal cavities arise changes in respiratory function including sluggish thoracic movements and pulmonary compliance in thoracic cavity, reduced inspiratory capacity and falling of diaphragm (**JE Park et al, 2012**)⁴.

Patanjali, who spread the idea of yoga worldwide, explained pranayam as the gradual unforced cessation of breathing and Asanas as different postures that make muscles more flexible and stronger. Regular yoga practice may improve breath holding time (BHT) due to stretch receptors which withstand more stretching. Yoga postures (Asanas) involve isometric contraction which is known to increase skeletal muscle strength. Pranayama practices, stretches the lung tissue producing inhibitory signals from action of slowly adapting receptors and hyperpolarising currents. These inhibitory signals coming from cardiorespiratory region involving vagi are believed to synchronize neural elements in the brain leading to changes in the autonomic nervous system; and a resultant condition characterized by reduced metabolism and parasympathetic dominance (**PA Balaji et al, 2012**)^{5,6,7&8}

2. MATERIALS AND METHOD:

This study was conducted in yoga lab in Dept. of physiology, Index Medical College, Indore, for a period of 12 weeks, where Yoga was practiced 6 days/week. Duration of yoga was 60 mins divided into 10 mins for meditation, 15 mins for pranayama and 35 mins for Asanas.

Subjects were selected from M.B.B.S., B.D.S and Paramedical Students are kept into two groups, yoga group (n = 87) and control group (n = 88).

Following materials were part of study:

1. Yoga lab
2. Yoga instructor
3. Medical students
4. Desktop Spirometer
5. Digital weight scale
6. Digital Height scale
7. Equipped Pathology Lab.

8. Lab Technicians

Inclusion criterion for participants:

1. Willing to participate and to continue Yoga practice
2. Subject should be physically fit
3. Normal personal and family health status

Exclusion criterion for participants:

1. Previous history of Yoga Practice
2. Any history of major illness like Stroke, Seizure, Vertigo, Hypertension, Coronary artery disease, Congenital heart disease, History of status asthmaticus, Peptic ulcer disease, Spondylitis, Joint pain, prolapsed disc, CSOM, Hernia, Physical inability to practice Yoga or any other disease condition which may exaggerate discomfort.
3. Any addiction

First year medical students were counseled and motivated for taking part in study.

Informed and written consents were taken before their participation. All first-year students were interviewed personally and their personal and family history were taken. Their personal history included their Daily routines, dietary habit, exercise habit etc. The participants (N = 175, including males and females) were randomized into two groups (Yoga group and control group) by computer generated list of random numbers. Randomization were done by independent assistant with concealment. There were 87 (45 males and 42 females) in yoga group and 88 (80 males and 08 females) in control group.

Yoga instructor instructed Yoga group, a specific yoga module 1 hr/day, six days a week, for twelve weeks. Control group was not given any such type of instruction, but was kept in touch with, till twelve weeks for final evaluation.

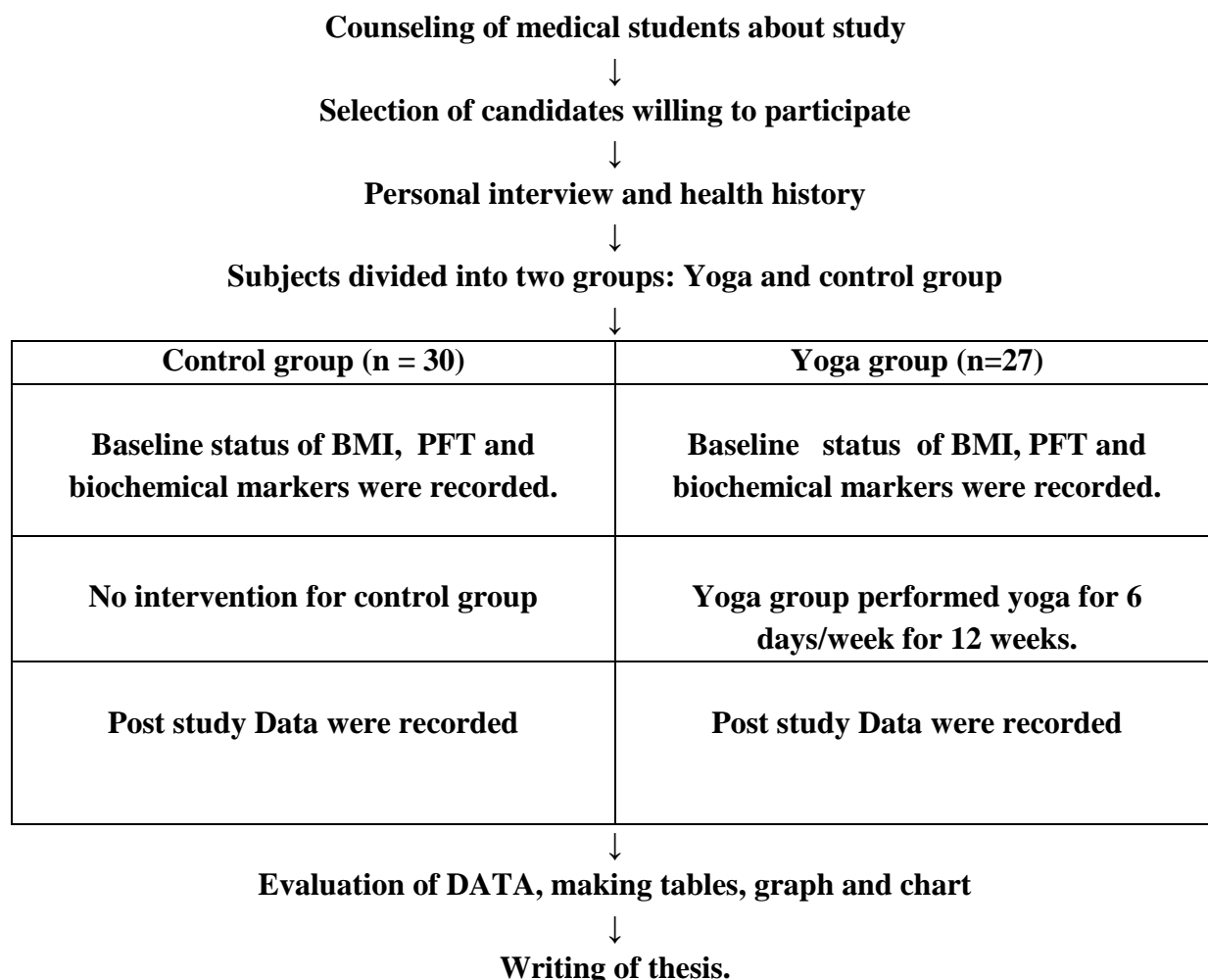
YOGA MODULE:



1. Meditation 5 minutes daily for 6 days /week.
 - Focused attention meditation by chanting ‘OM’
2. Asanas 30 mins daily for 6 days/week.
 - Surya-namaskar
 - Balasan
 - Parvat-asan
 - Bhujang-asan
 - Setu-bandhasan
 - Sarvangasan
3. Pranayam 15 mins daily for 6 days/week
 - Bhastrika
 - Kapalbhati
 - Anulom vilom
 - Bhramari
4. Relaxation 10 mins daily for 6 days/week
 - Yognidra / shavasan

Following Yoga were standardized for yoga group according to their data which was to be recorded for study. Before study, Data were recorded using above mentioned scales and preserved for further analysis after study. No questionnaire was used before, during and after study, but health related history and subject’s daily routine including sleep time, sleep duration and early morning awake time were recorded pre- and post-study.

Data were summarized as means \pm standard deviation and analysed using t test in SPSS-20. Table has been prepared using Microsoft office 2007 and graph was prepared with the help of Graphpad Prism 06.



OBSERVATION

This study was conducted in Yoga Lab, Dept. of physiology, Index Medical College, Indore. In this study, all the protocol was followed, as it was mentioned in Performa submitted. The purpose of this study was to compare the effect of yoga on various physiological and biochemical parameters like BMI, pulmonary functions and biochemical stress and immunological markers like Cortisol and DHEAS (Dehydroepiandrosterone sulphate).

Morning S. Cortisol and S. DHEAS were measured and samples were collected between 6.00 AM to 8.00 AM in biochemical lab. , a day before start of study and a day after 3 months of yoga practices. BMI is calculated through quetelet method and pulmonary parameters like FVC, FEV₁, PEF and FVC/FEV₁ were also analyzed through desktop spirometer before and after study.

Observation tables and graphs were made and compared between Yoga and control group participants.

TABLE 01. PRE- AND POST STUDY SERUM CORTISOL LEVEL IN YOGA GROUP

YOGA GROUP	PRE-STUDY (MEAN±SD)	POST-STUDY (MEAN±SD)	% CHANGE
TOTAL SAMPLE (N= 87)	572.18 ± 168.03	544.98 ± 139.89	4.8 % DECREASE
DECREASING PATTERN (N=52)	606.73 ± 110.20	571.74 ± 124.97	5.7% DECREASING
INCREASING PATTERN (N=35)	414.64 ± 141.31	432.51 ± 136.87	4.3% INCREASE

Table 01. Shows change in serum Cortisol level in yoga group (N=87) where S. Cortisol decreased in 52 (60%) participants (decrease by 5.7%) whereas increased in 35 (40%) participants (increased by 4.3%). Overall decrease in S. Cortisol level in Yoga group after 12 weeks of Yoga practice (1 hr./Day for 6 Days/week) were 4.8% (P Value < 0.05, significant).

Table 02. Pre- and Post-study S. Cortisol in control group

CONTROL GROUP	PRE-STUDY (MEAN ± SD)	POST-STUDY (MEAN ± SD)	% CHANGE
TOTAL PARTICIPANTS (N = 28)	558.89 ± 162.69	577.26 ± 254.5	3.4 % increase
INCREASING PATTERN (N = 63)	442.19 ± 169.74	483.57 ± 187.48	9.2% increase
DECREASING PATTERN (N = 25)	619.90 ± 412.97	602.73 ± 373.37	3% decrease

Table 02. Illustrates that among 88 participants in control group, 72% (N=63) have shown increasing pattern (increased by 9.2%) whereas 28% (N= 25) have shown decreasing pattern (decreased by 3%). Overall increase in S. Cortisol level in control group were 3.4% (P Value= 0.74, not significant)

TABLE 03. RELATIVE CHANGES IN S. CORTISOL LEVEL IN YOGA AND CONTROL GROUP

Sample size	87 participants*	88 participants*
Decreasing pattern	60% participants (N=52)	28% participants (N= 25)
Increasing pattern	40% participants (N=35)	72% participants (N= 63)
Overall changes in S. Cortisol level	4.8% Decreased (P value <0.05)	3.4% increase (P value = 0.74)

Table 03. shows changes in Serum Cortisol level in both Yoga and Control group participants. There were more number of participants in yoga group whose serum Cortisol level is decreased whereas lesser number of participants in control group whose Cortisol decreased.

Inversely, increase in serum Cortisol level were seen in control group (67%) participants but in yoga group only 40% participants have shown mild increase in Cortisol.

*Study started with 90 participants in each group but there were 3 participants in yoga group and 2 participants in control group left the study in-between.

TABLE 04. PRE- AND POST STUDY EFFECT OF YOGA ON S. DHEA(S) LEVEL

YOGA GROUP	PRE-STUDY (MEAN± SD)	POST STUDY (MEAN ± SD)	% CHANGE
TOTAL SAMPLE (N= 87)	3.5 ± 2.48	3.61 ± 1.73	3.1% increase
INCREASING PATTERN(N=52)	3.81 ± 0.86	4.28 ± 1.06	13% increase
DECREASING PATTERN(N=35)	3.06 ± 1.08	2.53 ± 1.34	17.3% decrease

Table 04. shows change in S. DHEAS level in Yoga group (N=87). S. DHEAS level has increased in 63% (N= 52, increases by 13%) whereas decreased in 37% participants (N= 35 ,decreases by 17.3%). Overall DHEAS level in Yoga group increases by 3.1% (P Value= 0.025, significant at 0.05).

TABLE.05 PRE- AND POST-STUDY S. DHEA(S) LEVEL IN CONTROL GROUP

CONTROL GROUP	PRE- STUDY (MEAN \pm SD)	POST- STUDY (MEAN \pm SD)	% CHANGE
TOTAL SAMPLE (N=88)	3.36 \pm 1.98	2.58 \pm 1.49	23.2% decrease
INCREASING PATTERN (N=63)	2.48 \pm 1.37	4.08 \pm 1.26	64.5% increased
DECREASING PATTERN (N=25)	3.81 \pm 1.78	1.92 \pm 1.60	50% decrease

Table 05. states about the pattern increase and decrease in S. DHEAS level in control group (N=88). 71.4% (N= 63) have reported decrease in their DHEAS level(decreases by 50%) whereas 28.6% (N= 25) have shown increase in their hormone level(increases by 64.5%). Overall S. Cortisol level decreases by 23.2% (P value= 0.84, not significant)

TABLE 06. RELATIVE CHANGE IN S. DHEAS LEVEL IN YOGA AND CONTROL GROUP

	YOGA GROUP	CONTROL GROUP
Sample size	87 PARTICIPANTS*	88 PARTICIPANTS*
Decreasing pattern	37 % participants(N=35)	71.4% participants (N= 63)
Increasing pattern	63% participants (N= 52)	28.6% participants (N= 25)
Overall change in S.DHEAS level	3.1% increase (P Value = 0.0251)	23.2% Decrease (P Value = 0.847)

Table- 06 shows change in serum DHEAS level in Yoga and Control group participants. There were more Participants in yoga group , whose serum DHEAS level has increased whereas lesser participants in control group whose hormonal level was increased. There was overall decrease in S. DHEAS level in control group as compared to yoga group where it has increased.

*Study started with 90 participants in each group but 3 in Yoga gr. And 2 in Control gr. left the study in-between.

TABLE 07. PRE- AND POST- STUDY FVC IN YOGA GROUP

YOGA GROUP	Pre-study (Mean± SD)	Post –study (Mean ± SD)	%CHANGE
Total sample (N= 87)	3.26 ± 0.65	3.45 ± 0.63	5.8% increase
Increased (N =71)	3.17 ± 0.87	3.65 ± 1.31	15.1% increase
Decreased (N =16)	3.36 ± 0.98	2.97 ± 1.09	18% decrease

In Table 07. FVC is increased in 81.48% participants (N=71, increased by 15.1%) whereas 18.5% (N=16) participants have shown decrease in FVC (decreases by 18%). Overall FVC in yoga group participants increased by 5.8% (P Value = 0.03, significant at 0.05)

TABLE 08. PRE- AND POST STUDY FVC IN CONTROL GROUP

Control group	Pre- study (Mean ± SD)	Post study (Mean± SD)	% Change
Total sample (N= 88)	3.09 ± 0.64	3.17 ± 0.68	2.5 % increase
Increasing pattern (N=48)	3.17 ± 0.71	3.28 ± 0.63	3.4 % increase
Decreasing pattern (N=40)	3.04 ± 1.04	2.96± 0.89	2.6 % decrease

Table 08. Represents Pre- and Post-study FVC in control group (n= 88) where 54% (N=48) participants have shown increasing pattern (increased by 3.4%) and rest 46.4% (N=40) have shown decreasing pattern (decreased by 2.6%). Overall FVC in Control group increases by 2.5% (P Value= 0.26, not significant)

TABLE 09. COMPARISON OF FVC IN YOGA AND CONTROL GROUP

	Yoga group	Control group
Sample size	87 participants	88 participants
Increasing pattern	81% participants (N=71)	54% participants (N= 48)
Decreasing pattern	19% participants (N=16)	46% decreasing (N=40)
Overall change in FVC	5.8% increase (P Value= 0.0316)	2.5% increase (P Value= 0.262)

Table 09. shows Forced Vital capacity in yoga and control group participants. There were more participants (81%) in yoga group whose FVC has increased in comparison to control group participants (54%).

TABLE 10. PRE- AND POST STUDY FEV₁ IN YOGA GROUP

Yoga group	Pre-study (Mean \pm SD)	Post-study (Mean \pm SD)	% Change
Total sample (N=87)	2.69 \pm 0.63	2.83 \pm 0.62	5.2% increase
Increasing pattern (N=58)	2.76 \pm 0.60	3..11 \pm 0.65	12.6% increase
Decreasing pattern (N=29)	3.07 \pm 0.91	2.72 \pm 0.97	11.4% Decrease

Table 10. shows pre- and post-study fluctuations in Yoga group (N=87) where 67% participants have shown increase in FEV₁(increases by 12.6%) whereas only 33% have shown decrease in FEV₁(decreases by 11.4%). Overall increase in FEV₁ in yoga group is 5.2% (P Value= 0.09, significant at 0.1)

TABLE 11. PRE- AND POST STUDY FEV₁ IN CONTROL GROUP

Control group	Pre-study (Mean \pm SD)	Post-study (Mean \pm SD)	% Change
Total sample (N=88)	2.63 \pm 0.61	2.71 \pm 0.63	3.04 % increase
Increasing pattern (N=54)	2.97 \pm 0.88	3.09 \pm 0.67	4 % increase
Decreasing pattern (N=34)	2.84 \pm 1.02	2.78 \pm 0.99	2.11 % decrease

Table 11. shows increasing and decreasing pattern of control group (N=88) where 61 % (N=54) have shown increasing pattern (increases by 4%) and 39% (N= 34) have shown decreasing pattern(decreases by 2.11%). Overall FEV₁ in control group increases by 3.04% (P Value not significant)

TABLE 12. PRE- AND POST STUDY FEV₁ IN YOGA AND CONTROL GROUP

	Yoga group	Control group
Sample Size (N)	87	88
Increasing pattern	67% participants	61% participants
Decreasing pattern	33% participants	39% participants
Over-all FEV₁	5.2% increase (P value= 0.09)	3.04% increase (P value= 0.329)

Table 12. compares Pre- and post-study FEV₁ of yoga and control group. 67%(N= 58) have shown increasing pattern in comparison to control group(61%, N=54) participants. Overall increase was more for yoga group participants.

TABLE 13. PRE- AND POST-STUDY EFFECT OF YOGA ON PEF

Yoga group	Pre- study (Mean \pm SD)	Post-study (Mean \pm SD)	Percent Change
Total Sample (N= 87)	2.84 \pm 0.7	3.81 \pm 0.62	34% increase
Increased Pattern (N= 68)	2.95 \pm 0.96	4.03 \pm 0.71	37% increase
Decrease pattern (N=20)	3.62 \pm 0.84	3.49 \pm 0.72	4% decrease

Table13. shows that there is an overall increase in PEF by 34% in yoga group participants (N=87). 78% (N=68) participants have shown an increasing pattern (increased by 37%) whereas 22% (N=20) have shown decreasing pattern (decreased by 4%).

TABLE 14. PRE- AND POST STUDY PEF IN CONTROL GROUP

CONTROL GROUP	PRE-STUDY (MEAN \pm SD)	POST-STUDY (MEAN \pm SD)	PERCENT CHANGE
Total sample (N= 88)	2.45 \pm 0.91	2.49 \pm 0.65	1.6% Increase
Increasing pattern (N=54)	2.54 \pm 0.89	2.95 \pm 0.71	15.7% increase
Decreasing pattern (N=34)	2.80 \pm 0.66	2.38 \pm 0.71	15% decrease

Table 14 shows change in Peak expiratory flow rate in control group participants (N=88) . 61% (N= 54) participants have shown increasing pattern(increased by 15.7%) whereas 39% (N= 34) have shown decreasing pattern(decreased by 15%). Overall rise in PEF is 1.6%.

3. DISCUSSION

This study was performed in Yoga lab, Dept. of physiology, Index Medical College, Indore. The purpose of this study was to compare the effect of Yoga on various physiological and biochemical parameters in yoga practitioners in respect to control group. Study started with 30 participants in each group but there were 3 dropouts in yoga group participants⁹. The physiological markers in this study were BMI and parameters of pulmonary functions. Biochemical markers were Serum Cortisol and Immune-enhancer DHEAS (Dehydro-epiandrosterone sulfate)¹⁰.

Serum Cortisol level is the marker of stress and inflammation. Higher Cortisol level means high stress level. Yoga and meditation is documented to reduce stress level in regular practitioners. Pre and post study morning S. Cortisol level in Yoga group was 572.18 ± 168.03 and 544.98 ± 139.89 respectively (P value < 0.05, 4.8 % decrease). Value was calculated in nmol/lit. There were 60% participants in yoga group where S. Cortisol decreased from 606.73 ± 110.20 to 571.74 ± 124.97 (5.7% decreasing). 40% participants have shown increase in their Hormone level from 414.64 ± 141.31 to 432.51 ± 136.87 (4.3% increase). Whereas in control group participants (N=28), there were overall increase in Cortisol level from 558.89 ± 162.69 to 577.26 ± 254.5 (P value 0.74, 3.4 % increase). In control group, 28% participants have shown decreasing pattern in their Cortisol from 619.90 ± 412.97 to 602.73 ± 373.37 (8% decrease) and 72% have shown increasing pattern from 442.19 ± 169.74 to 483.57 ± 187.48 (9.2% increase).

Above mentioned S. Cortisol levels in both Yoga and Control group states that yoga and meditation have beneficial effect on stress level. There were more yoga practitioners in whom Serum Cortisol level has decreased after 3 months of yoga with respect to control group who were non- yogic but occasional athlete. Although 40% of Yoga practitioners have shown mild increase in their post study Cortisol level but all levels were in normal limits.

Lin SL et al (2015)¹¹ reviewed those participants doing yoga experienced a significant reduction in work-related stress ($t = -6.225$, $p < .001$), and a significant enhancement of stress adaptation ($t = 2.128$, $p = .042$). Participants in the control group revealed no significant changes. Comparing the mean differences in pre- and post-test scores between yoga and control groups, they found that yoga group significantly decreased work-related stress ($t = -3.216$, $p = .002$), but there was no significant change in stress adaptation ($p = .084$).

KKF Rocha et al (2012)¹² elaborated that Yoga is believed to have beneficial effects on cognition, attenuation of emotional intensity and stress reduction. They investigated the effects of yoga on memory and psycho-physiological parameters related to stress, comparing yoga practice and conventional physical exercises in healthy men. They measured salivary Cortisol level before and after study and observed that Yoga decreases anxiety, depression and stress-related measures as the morning Cortisol decreased after study.

DHEAS or Dehydro-epiandrosterone sulfate is usually praised for its anti-aging properties. It can protect the heart and improve brain function and act as anti-cortisol hormone. Yoga also improves its circulating level in blood. Pre and post study S. DHEAS in Yoga group were 3.5 ± 2.48 and 3.61 ± 1.73 respectively. (P value= 0.0251, 3.1% increase). There were 63%

participants in yoga group whose DHEAS level increased from 3.81 ± 0.86 to 4.28 ± 1.06 (13% increase) and 37% participants whose hormone level decreases from 3.06 ± 1.08 to 2.53 ± 1.34 (17.3% decrease). Whereas control group Pre- and post-study DHEAS level were 3.36 ± 1.98 to 2.58 ± 1.49 (23.2% decrease). 71.4% participants have shown their decrease in hormone level from 3.81 ± 1.78 to 1.92 ± 1.60 (50% decrease) and 28.6% participants have shown their increase from 2.48 ± 1.37 to 4.08 ± 1.26 (64.5% increased)¹³.

Hence from above data, it is very clear that yoga practitioners have more rise in their DHEAS level in comparison to control group participants whose post DHEAS has decreased.

4. CONCLUSION

This study was conducted in Yoga Lab, Dept. of physiology, Index Medical College, Indore. In this study, all the protocol was followed, as it was mentioned in Performa submitted. The purpose of this study was to compare the effect of yoga on various physiological and biochemical parameters like BMI, pulmonary functions and biochemical stress and immunological markers like Cortisol and DHEAS (Dehydroepiandrosterone sulphate). Another control group was also kept in touch for comparison.

01. Yoga decreased some body mass in those who were overweight but didn't reduced weight in normal individuals. Yoga group have shown mild decrease in BMI (P Value = 0.08, significant at <0.1)) whereas variation in control group was more (P Value = 0.088). Hence it is clear that yoga also maintains normal appetite and maintains body weight to a level.
02. Yoga decreased stress by decreasing Serum Cortisol level in yoga practitioners (P Value <0.05, significant) whereas control group have shown sharp increase in hormone level (P Value = 0.74, not significant). Hence Yoga improved lifestyle in millennials who were stressed due to academic burdens.
03. Yoga also have shown its direct impact on Dehydroepiandrosterone and increases its level in yoga group participants (P Value < 0.05, significant). Whereas control group have shown decrease in immunogenic hormone level (P Value not significant). Hence yoga can improve immunity, delays aging process and also prevents cardiovascular risk factors.

5. REFERENCES

- [1] Madanmohan, Bhavanani AB, Dayanidy G, Zeena S, Basavaraddi IV. Effect of Yoga therapy on reaction time, biochemical parameters and wellness score of peri and post menopausal diabetic patients. *International J Yoga* 2012; 5: 10-15.
- [2] Shinde N, Shinde KJ, Khatri SM, Hande D (2013) A Comparative Study of Yoga and Aerobic Exercises in Obesity and its Effect on Pulmonary Function. *J Diabetes Metab* 4:257. doi:10.4172/2155-6156.1000257
- [3] Ashutosh chauhan, Deepak kumar Semwal, Satendra pd. Mishra, and Ruchi Badoni Semwal *Int. J Yoga* 2017 May-Aug; 10(2): 103–106.

- [4] Park JE, Chung JH, Lee KH, Shin KC. Tuberc Respir Dis (Seoul). 2012 May;72(5):433-40. doi: 10.4046/trd.2012.72.5.433. Epub 2012 May 29.
- [5] P A Balaji, Smitha R Verne, Sayed Sadat Ali N Am J Med Sci. 2012 Oct; 4(10): 442–448. doi: 10.4103/1947-2714.101980
- [6] Keshur A. Karmur, Varsha S. Joshi, Maulik S. Padalia and Jitesh L. Sarvaiya International Journal of Biomedical and Advance Research 2015; 6(09): 682-685.
- [7] Aarti S Mahajan International Journal of Clinical and Experimental Physiology 2004; vol.1 (3): 173 – 178.
- [8] Sridip Chatterjee, Samiran Mondal Evidence-Based Complementary and Alternative Medicine Volume 2014 (2014), Article ID 240581, 15 pages
- [9] Ashutosh Chauhan, Deepak Kumar Semwal, Satyendra Prasad Mishra, Ruchi Badoni Semwal International journal of yoga 2017;vol. 10(2) : 103-106.
- [10] Seema Patel, Kamakhya Kumar, A study on the effect of Yoga and diet control on Body mass index and cholesterol level of the Obese Youth, International Journal of Science and Consciousness; March 2016, 2(1), 13-17.
- [11] Lin SL, Huang CY, Shiu SP, Yeh SH; Effects of Yoga on Stress, Stress Adaption, and Heart Rate Variability Among Mental Health Professionals--A Randomized Controlled Trial; Worldviews Evid Based Nurs. 2015 Aug;12(4):236-45. doi: 10.1111/wvn.12097. Epub 2015 Jul 28.
- [12] KKF Rocha, A.M.Ribeiro, KFC Rocha, Conscious Cogn. 2012 Jun;21(2):843-50. doi: 10.1016/j.concog.2012.01.014. Epub 2012 Feb 17.
- [13] Anne M. Kenny, Rebecca S. Boxer, Alison Kleppinger ,Jennifer Brindis Int J yoga ; vol 7Issue 9 :September 2010 Pages 1707–1714.