

“Effect Of Yogic Exercise Module On Aerobic Capacity In Young Adult Males -A Study In Central India”

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Abstract:

Introduction –Yoga is a science that's being practiced in India over thousands of years which facilitates homeostasis, an ancient way of life intended to improve the quality of life, general health and fitness of an individual. Practice of yogic exercise have proposed to alter the aerobic capacity of individual. Physical fitness depends upon cardiorespiratory endurance of an individual which can be determined by VO₂ max.

Aim and objectives- To assess the effect of yogic exercise module on aerobic capacity (VO₂ max).

Methodology –Total forty, first year MBBS male students, age 18-20 years with normal body mass index were included in the study. They performed yogic exercise in the form of module which included a set of physical postures (asana), breathing techniques (pranayama), and meditation (dhyana) for 35mins, 5times /week for 6 months. VO₂ max was assessed using (AD-Instrument) pre and post interventional.

Results- Mann Whitney U test was used to compare pre and post interventional results. VO₂ max was found to be increased after 6 months practice of yogic exercise. P < 0.05 was considered statistically significant.

Conclusion: Aerobic capacity of young adult participants was found to be enhanced after 6 month's practice of yogic exercise module.

Keywords – Yogic exercise, Aerobic capacity, VO₂ max.

INTRODUCTION-

In Sanskrit word yoga means yoke or union. Yoga unites individual self with the cosmic consciousness. Yoga is a science being practiced in India over thousands of years. It facilitates homeostasis, an ancient way of life intended to improve the quality of life, general health and fitness of an individual⁽¹⁾. It produces consistent physiological changes and have sound scientific basis. Yoga is psychophysical in character due to the continuous focus on the body, breathing and mind. It is also a spiritual tool with enhanced health and well-being as one of its positive effects.

The origin of yoga has occurred in India thousands of years ago. It is a method of learning that aims to attain the unity of mind, body and spirit through three main yoga structures: exercise,

breathing and meditation. Yoga is a great form of exercise and a mind –body practice that can have physical, mental and emotional benefits ⁽²⁾. Yoga uses psychophysical energy movements including specific body postures (asana), breathing exercises (pranayama) and concentration exercises (dharana) for the mind which are very commonly applied for health benefits and are found to be beneficial for better maintenance of body functions even in normal healthy subjects ⁽³⁾. It has been observed that asana in yoga resembles more of a physical exercise, which may lead to the perception that yoga is another kind of physical exercise. The Oxford English dictionary defines exercise as ‘Activity requiring physical effort, carried out to sustain or improve health and fitness’ ⁽⁴⁾. Practice of physical postures (asana) improves the muscle strength, flexibility, mind-body coordination and balance. At cellular level there occurs improvement in the blood flow, tissue perfusion and oxygenation.

Focusing on one’s own breathing (pranayama) while practicing yoga body movements, and vice versa can function as a tool to increase awareness of tension/relaxation states ⁽⁵⁾. Technique of breathing pranayama helps us to control our emotions & also influences our vital energy sheath. Slow, deep and rhythmic breathing is ideal for controlling stress and overcoming emotional hang-ups. The practice of pranayama helps us to regulate our emotions and stabilize the mind. We can observe that our breathing becomes rapid when we are angry and it is slower when we are cool and relaxed. Thus, slow, rhythmic and controlled breathing in pranayama leads to the emotional control seen in many yoga sadhakas.

Meditation (dhyana) helps us to focus our mind and dwell in it to channelize our energy in a holistic manner towards the right type of evolutionary activities. Also makes us to understand our self-better to become better humans in this social world ⁽⁶⁾. It acts by calming down the mind, improves the concentration thus helps in enhancing work output. By maintaining tranquillity of mind, it can promote clear thinking, better judgment and effective decision making. ⁽⁷⁾. It is a state which eliminates unnecessary thought, effortless attention on the present moment. In order to experience the real essence of yoga - the full integration of body, mind and soul, the ability to calm mental turbulence is essential ^(4, 8).

Fitness level of an individual depends on oxygen which can be transported by the body to working muscles to use that oxygen, hence maximum oxygen uptake capacity is widely considered to be reliable indicator of fitness. It is a measure of aerobic capacity has been determined as the international standard of physical activity ⁽⁹⁾. VO₂max refers to the intensity of aerobic process and actually denotes the maximum capacity to transport and utilize oxygen during exercise done at increasing intensity. It is the highest rate of oxygen consumption attainable during maximal exercise. The basic unit of measuring the maximal oxygen uptake is its absolute value expressed in liters or milliliters per minutes. However, the absolute value is highly affected by body weight so it is often expressed as ml/kg/minutes ⁽¹⁰⁾.

Accurate ways to assess VO₂ max are through maximal graded exercise test, performed to volitional exhaustion on motorized treadmill or cycle ergometer while expired air is analyzed continuously by gas analyzer. At present costly equipment and staff training limits direct measurement of VO₂ max also very few studies demonstrating effect of yogic module on aerobic fitness of healthy young males are available hence forth this study was undertaken.

MATERIAL AND METHODS

Study setting: Study was conducted in Exercise Physiology Laboratory in Department of Physiology and gymnasium of Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha.

Study design: Prospective interventional study

Study duration: One year

Sample size: Considering drop out, sample size kept was 10% more than expected. Forty-two first year MBBS male students were recruited as participants in each group of age 18-20 years with normal body mass index from Jawaharlal Nehru Medical College, Sawangi (M), and Wardha.

Sample size calculation for testing a hypothesis in interventional studies ⁽¹¹⁾

Sample size = $2SD^2(Z_{\alpha/2} + Z_{\beta})^2$

d^2

SD = Standard Deviation from previous studies

or pilot study ⁽¹²⁾
=5.2
 $Z_{\alpha/2} = Z_{0.025} = 1.96$ (from Z-table as Type I error)
 $Z_{\beta} = Z_{0.050} = 0.842$ (from Z-table) at 80% power
d=effect size
=difference between mean values
=69.8-66.5
=3.3
Sample size = $\frac{2 \times 5.2^2 (1.96 + 0.84)^2}{3.3^2}$
=37.98 approx in each group.

Criteria for selection

Inclusion criteria:

1. First year MBBS male students from Jawaharlal Nehru Medical College, Sawangi (M), Wardha.
2. All participants with age, BMI and sex matched.
3. Participants who had volunteered and given written consent.

Exclusion criteria:

1. Previous experience of yogic exercises.
2. Participants addicted to smoking and drinking.
3. Suffering from or diagnosed with any chronic diseases.
4. Participants with Chronic Obstructive Pulmonary Disease, cardiovascular disorder, hypertension or diabetes.
5. Participants suffering from any psychiatric illness.
6. Recent surgical procedures during the previous 6 months.

Study Protocol

Detailed plan of work, aim of present research project were explained to participants and briefed regarding study protocol. Written informed consent was obtained from them.

Measurement of parameters:

Prior to the day of recording of parameters all the participants were familiarized with the laboratory environment and were instructed regarding experimental procedures. On the day of recording they were advised to abstain from tea, coffee and any medication 24hr prior to recording of parameters. Recordings were done in morning after a light breakfast. All the parameters were recorded prior to the study and after six months completion of study.

1. BMI -

Height without shoes was measured to the nearest 0.1cm using a standard meter. Body weight was measured using standard calibrated clinical weight scale in light indoor clothes to the nearest 0.1kg. Body Mass Index (BMI) = Weight in Kilograms (kg)/ (Height in meter)²

2. VO₂ max -

Participants were asked to perform the maximal GXT on a treadmill (Precor 9.1/9.2, Ambala). In treadmill GXT, protocol participants were required to walk at a brisk pace at level grade for 3 min, followed by jogging at a self- selected speed at level grade (4.3-7.5 mph) for an additional 3 minute ⁽¹³⁾. Participants used hand signals to inform the test administrator when a comfortable jogging pace was achieved. Thereafter, the treadmill grade was increased 2.5% every min (treadmill speed remaining constant), until participants achieved volitional fatigue, and were unable to continue despite verbal encouragement. Heart rate-max (HR) was recorded as the highest observed HR during the final stages of the GXT. Metabolic analyzer was used to measure oxygen consumption (AD instrument). The highest full-minute oxygen uptake value observed during the final stages of the GXT was recorded as VO₂max. VO₂ values were considered maximal when at least two of the following three criteria were satisfied ⁽⁸⁾

Respiratory expiration ratio ≥ 1.1

Maximal HR of <15 bpm below age-predicted HR max (220-age) and

Leveling off of VO₂ despite an increase in work.

Intervention –

Participants were given moderate intensity yogic exercise for 35 minute’s duration in the form of module. It included asana, pranayam and meditation. Sequence of asana were Suryanamaskar (sun salutations), Trikonasana, Tadasana and Sukhasana. According to some author’s sun salutations postures had metabolic values higher than treadmill walking at 3.2 km/hour and they were not significantly different than ACSM recommended minimum values for moderate levels of exercise intensity (3.0 METs) ⁽¹⁴⁾. Some studies found sun salutations to be strenuous form of yoga practice involving continuous movement and were comparable to walking 4.8 km/hour on a treadmill which might provide enough intensity to improve cardiorespiratory fitness in sedentary individuals ⁽¹⁵⁾. Sequence of pranayama were Anulom-Vilom, Kapalbhathi which was followed by meditation. They were taught asana, pranayama by certified yoga trainer. They were trained for a period of week during which they were shown pictures, diagrams and audio cassettes related to yogic exercise for 45 minutes. Out of which last 20 minutes were devoted to a guided commentary ⁽¹⁶⁾.

Data Analysis:

All data obtained were presented as mean and standard error of mean. Statistical Package for the Social Sciences software (version 20) was used for data analysis.

Table -1. Age wise distribution of participants

Sr no	Age group (years)	Number of Participants
1	18	12(30%)
2	19	17(42.5%)
3	20	11(27.5%)
Total		40(100%)
Mean ±SD		18.87± 0.85

Interpretation-42.5% of the participants were of 19 years, 30% participants were of 18 years & 27.5% were of 20 years.

Table-2. BMI wise distribution of participants

Sr no	BMI (kg/m ²)	Number of Participants
1.	Underweight (< 18.5)	0%
2.	Normal Weight (18.5-24.9)	40(100%)
3.	Overweight (25-29.9)	0%
4.	Obese (≥30)	0%
Total		40(100%)
Mean ± SD		23.26±6.02

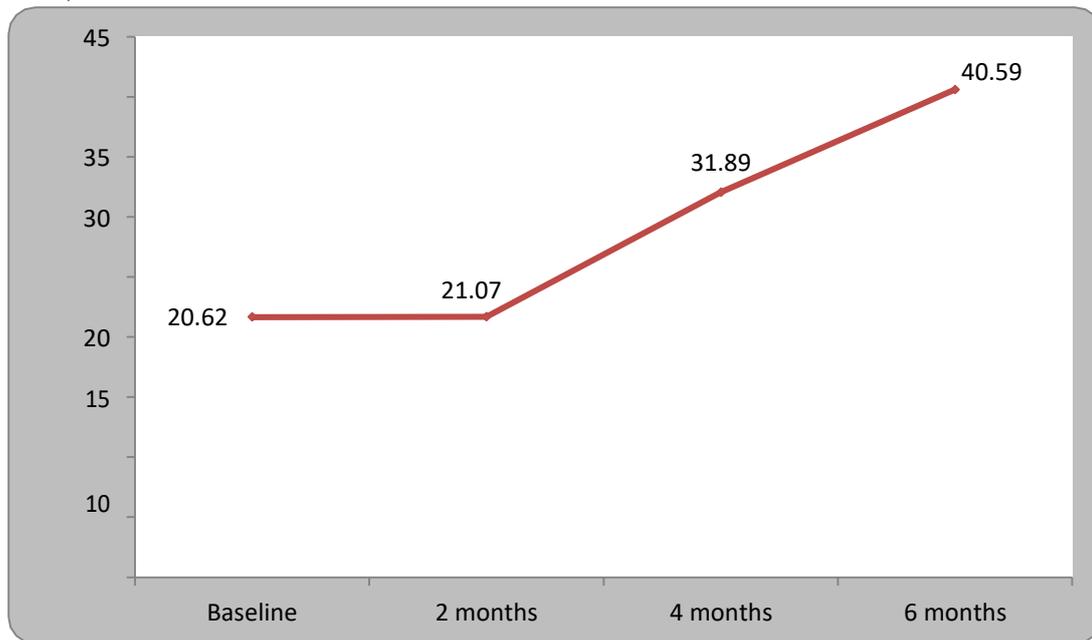
Interpretation-All (100%) of the participants were having normal BMI (18.5-24.9).

Table-3. Effect of Yogic Exercise on VO2 Max

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	Z-value	p-value
Baseline	20.62	40	1.65	0.25	-	-	-
2 month	21.07	40	1.67	0.26	0±0	0.00	1.00, NS

s							
4 months	31.89	40	3.58	0.56	8.32±2.71	5.32	0.0001, S
6 months	40.59	40	3.16	0.49	18.45±3.32	5.31	0.0001, S

Interpretation-Mean VO₂ max at baseline was 20.62±1.65, at 2 months it was 21.07±1.67, at 4 months it was 31.89±3.58 and at 6 months it was 40.59±3.16. By using Wilcoxon Signed Rank Test statistically no significant improvement was found at 2 months (z=0.00, p-value=1.00) and significant improvement was found at 4 months (z=5.32, p<0.05) and at 6 months (z=5.31, p<0.05).



Discussion-

Physical fitness of an individual depends on its cardio respiratory endurance. VO₂max (maximal oxygen uptake/maximal aerobic power/aerobic capacity) is widely accepted as the best measure of cardio respiratory endurance.

Analysis of VO₂ max was done by using Wilcoxon signed rank test at the beginning of the study after two, four and six months of intervention. In present study 42.5% of the participants were of 19 years, 30% participants were of 18 years & 27.5% were of 20 years as shown in **Table-1**. All (100%) of the participants were having normal BMI (18.5-24.9) as shown in **Table-2**. On analysis of VO₂ max mean baseline value was 20.62±1.65, at 2 months it was 21.07±1.67, 4 months it was 31.89±3.58 and at 6 months it was 40.59±3.16. By using Wilcoxon signed rank test statistically no significant improvement was found at 2 months (z=0.00, p>0.05) but statistically significant improvement was observed at 4 months (z=5.32, p<0.05) and 6 months (z=5.31, p<0.05) as shown in **Table-3, Graph-3**.

In present study no changes were observed after two months of yogic exercise in VO₂Max.

Similar results were also observed in studies done by **Hovsepian et al., 2013**⁽¹⁷⁾ who studied three months effect of yoga on physical fitness parameters in 60 healthy participants & **Kodgire 2014**⁽¹⁸⁾ who studied two months effect of yoga on selected physiological variables of healthy individuals. In both the studies no improvement was observed in VO₂max after yoga training. They concluded that shorter term yoga training program was not able to

facilitate the uptake of oxygen in tissues and hence there was no increase in VO₂max in the participants.

Significant improvement in VO₂max after four and six months of yogic exercise intervention in our study are consistent with those of previous research who showed similar improvement in VO₂max as seen in study done by **Ray et al. 2001**, **Raju et al. 1997** and **Amutha, 2010**. Effect of hatha yoga exercise on aerobic capacity for six months duration was done by **Ray et al. 2001**⁽¹⁹⁾ who found that absolute value of VO₂ max increased significantly in the yoga group after 6 months of training. **Raju et al. 1997**⁽²⁰⁾ had found a significant increase in oxygen consumption per unit work after yoga training. They explained these changes on the basis that during meditation body achieves an altered state of consciousness in a brief period where relaxation response is produced causing metabolism of body to slow down also heart rate, blood pressure and breathing decreases which facilitates uptake of oxygen. Evaluation of the effects of yoga on anxiety levels and VO₂max were also observed by **Amutha, 2010**⁽²¹⁾ and **Jayachandran. K, 2014**⁽²⁾. They observed decrease in anxiety levels with increase in VO₂ max of the study participants and concluded yoga being driven by its characteristic prolonged breathing helps to dampen the causes of anxiety within one's mind which contributes in reduction of sympathetic activity and increase in maximal oxygen uptake. Similar results were seen in prospective interventional study done by **Doijad V, Kamble P, Surdi A 2013**⁽²²⁾ where increase in VO₂max after 12 weeks of yoga therapy was found. They suggested yogic exercise training brings generalized decrease in vascular tone due to stimulation of parasympathetic activity which helps in better utilization of oxygen at cellular level and contributing to increase aerobic capacity of participants. Also, **Lau C et al 2015**⁽²³⁾ examined the effects of a 12-week Hatha yoga on 173 adults and found that the yoga group achieved significant improvements in VO₂max ($P < 0.01$) as compared to control group. Increased VO₂max in the yogic exercise group after four months duration was also observed by **Meshram K et al 2017**⁽⁸⁾. Increase in muscular endurance caused by various yogic exercise postures results in better control of intercostal muscles that helps to improve lung functions could be the reason that would probably improve VO₂max^(24,25,26,27,28). Thus, overall increase in VO₂max after yogic exercise intervention in our study ensures good aerobic capacity in participants.

CONCLUSION-

VO₂max indicates physical fitness of an individual. Present study showed no increase in VO₂max after two months of yogic exercise training from which it could be concluded that short-term training program was not able to facilitate the uptake of oxygen in tissues and hence there was no increase in VO₂max while increased VO₂max after four and six months ensures good aerobic capacity in young participants of present study.

Limitation - Smaller sample size and only male participants were included in the study.

Future directions - Implementation of yogic exercise module in low cardio respiratory reserves participants, especially in patients in whom heavy exercises are contraindicated.

Acknowledgment - I am thankful to DMIMS (DU) for their kind support and providing fund to carry out research work & also want to thank all participants and Yoga trainer for their kind cooperation.

Conflict of interest - None declared

REFERENCES-

1. Vinay A V, Venkatesh D, Ambarish V. Impact of short-term practice of yoga on heart rate variability. *Int J Yoga* 2016; 9:62-6.
2. Jayachandran K. Effects of Yogic Practices on Physical Physiological and Psychological Variables among School Students. *International Journal of Recent Research and Applied Studies*. 2014; 1.1(17): 68-72.
3. Papp M E, Lindfors P, Storck N, Wandell P E. Increased heart rate variability but no effect on

- blood pressure from 8 weeks of hatha yoga – A pilot study. *BMC Research Note*. 2013; 6: 59.
4. Govindaraj R, Karmani S, VaramballysAndGangadhar B. Yoga and Physical Exercise – A Review and Comparison. *International review of psychiatry*. 2016; 28(3):242–253.
 5. Mzezewa, S., Setati, M., Netshiongolwe, T., &Sinoamadi, V. “ Prevalence of breast cancer in reduction mammoplasty specimens, in women of African origin: preliminary histology results at Mankweng and Polokwane hospitals. *Journal of Medical Research and Health Sciences*, (2020), 3(10), 1109-1113. <https://doi.org/10.15520/jmrhs.v3i10.264>
 6. SantaellaDF,DevesaCR,RojoMR,AmatoMB,DragerLF,CasaliKR,etal.Yoga respiratory training improves respiratory function and cardiac sympathovagal balance in elderly subjects: A randomized controlled trial. *BMJ Open* 2011; 1:e000085.
 7. BiswasDA,MeshramK, Pawar S.Effect of Rajyoga meditation on lipid profile in Type -2 Diabetes patients. *International Journal of Current Research*. 2019; 11(12): 8752-8755.
 8. Meshram K, Meshram A. Usefulness of Rajyoga meditation in assessment of general well being of badminton players an experimental study. *Int J Pharm Biol Sci*. 2016; 7(1):161-6.
 9. MeshramK,MeshramA,BiswasDA.ModulationofVo2 max by Rajyoga meditation in young adult males. *National Journal of Physiology Pharmacy & Pharmacology*. 2017; 8(1): 42-46.
 10. Saccomanni, B. “ Some Words About Fractures Of Radial Head. *Journal of Medical Research and Health Sciences*, (2020), 3(10), 1106-1108. <https://doi.org/10.15520/jmrhs.v3i10.261>
 11. Mona Kharbanda, AngeshBagade, AniruddhaJibhkate. Effect of Exercise on Aerobic Power and Correlation of Aerobic Power with Body Mass Index and Physical Fitness Score in Medical Students. *Asian Journal of Biomedical and Pharmaceutical Sciences*. 2015; 5(43): 21-26.
 12. Meshram K, Meshram A. Aerobic fitness in basket ball player-An experimental study in central India. *Journal of medical science and clinical research*.2018; 6(10): 791-797.
 13. Charan J, Tamoghna B. How to Calculate Sample Size for Different Study Designs in Medical Research? *Indian J Psychol Med*. 2013 Apr-Jun; 35(2): 121–126. doi:10.4103/0253-7176.116232
 14. Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. *Int J Yoga*. 2011 Jul-Dec; 4(2): 49–54.
 15. Albrecht, U., Stangeb, R., &Schermyly, N. (2020). Efficacy and Safety of The Herbal Combination Containing TropaeoliMajorisHerba and ArmoraciaeRusticanae Radix in Patients Suffering from Uncomplicated, Acute Rhinosinusitis: A Randomized, Double-Blind, Placebo Controlled, Two-Arm, Parallel Group, Phase. *Journal of Current Medical Research and Opinion*, 3(10), 665-681. <https://doi.org/10.15520/jcmro.v3i10.350>
 16. Pazare K, Biswas DA, Meshram AW. Modulation of anaerobic biomarker and lung functions by rajyoga meditation in young badminton players. *International Journal of Medical Science and Public Health* 2013; 2(3): 664-69. DOI: 10.5455/ijmsph.2013.250420133
 17. Hagins M, Moore W and Rundle A. Does practicing hatha yoga satisfy recommendations for intensity of physical activity which improves and maintains health and cardiovascular fitness? *BMC Complementary and Alternative Medicine*. 2007; 7(40); 1-9. doi:10.1186/1472-6882-7-40
 18. Ross A and Thomas S. The Health Benefits Of Yoga And Exercise: A Review Of Comparison Studies. *The Journal of Alternative and Complementary Medicine*. 2010; 16(1): 3–12.
 19. Kiran U., Behari M., Venugopal P. Vivekanandhan S., Pandey R.M. The effect of Autogenic relaxation on chronic tension headache and in modulating cortisol response. *Indian j Anaesthesia*. 2005; 49 (6): 474-478.
 20. Hovsepian V, Marandi SM, Kelishadi R, Zahed A. A Comparison between Yoga and Aerobic Training Effects on Pulmonary Function Tests and Physical Fitness Parameters. *Pak J Med Sci*. 2013; 29(1) Suppl: 317.
 21. AbidillahMursyid, Waryana, LastmiWayansari, WiworoHaryani (2017) Canteen Manager And Elementary Student Empowerment About Local Food To Combat AnemiaInternational Journal Of Scientific Research And Education.05,07 (July-17) 6726-33
 22. Tushar J. Palekar, Monica N. Dhanani, Ajay Malshikhare, ShilpaKhandare, (2017) Comparative Study of Conventional Tens Versus Phonophoresis Along With Exercises in Lateral Epicondylitis International Journal Of Scientific Research And Education.05,07 (July-17) 6711-17
 23. Kodgire UD. Comparative Effect Of Yoga And Aerobic Exercises On Selected Physiological

- Variables Of School Girls. IRMRJ. 2014.
24. Ray US, Mukhopadhyaya S, Purkayastha SS, Asnani V, Tomer OS, Prashad R, et al. Effect of yogic exercises on physical and mental health of young fellowship course trainees. *Indian J PhysiolPharmacol.* 2001; 45(1):37-53.
 25. Raju PS, Prasad KV, Venkata RY, Murthy KJ, Reddy MV. Influence of intensive yoga training on physiological changes in 6 adult women: A case report. *J Altern Complement Med.* 1997; 3(3):291-5.
 26. Amutha. Effect of selected Yoga Programme on Anxiety, VO₂max and Flexibility, *Journal of Physical Education and Sports Sciences.* 2010;2: 19-22
 27. Doijad VP, Kamble P, Surdi AD. Effect of Yogic Exercises on Aerobic Capacity (VO₂ Max). *International Journal of Physiology.* 2013; 1(2); 47-50.
 28. Lau C, Yu R, and Woo J. Effects of a 12-Week Hatha Yoga Intervention on Cardiorespiratory Endurance, Muscular Strength and Endurance and Flexibility in Hong Kong Chinese Adults: A Controlled Clinical Trial Evidence-Based Complementary and Alternative Medicine. 2015: Article ID 958727, 12 pages.<http://dx.doi.org/10.1155/2015/958727>.
 29. Khatib M, Sinha A, Gaidhane A, Simkhada P, Behere P, Saxena D, et al. A systematic review on effect of electronic media among children and adolescents on substance abuse. *Indian Journal of Community Medicine.* 2018;43(5):S66–72. https://doi.org/10.4103/ijcm.IJCM_116_18.
 30. Khatib MN, Kirubakaran R, Gaidhane S, Shankar AH, Quazi Syed Z. Yoga for improving functional capacity, quality of life and cardiovascular outcomes in people with heart failure. *Cochrane Database of Systematic Reviews* [Internet]. 2017;2017(7). <https://doi.org/10.1002/14651858.CD012015.pub2>.
 31. Bindi Desai, Didhiti Desai. To Compare The Effect of Specific Yoga and Aerobic Exercise Program on Vital Parameters in Young Adult Females *International Journal of Current Research and Review.* Vol 12 Issue 02, January, 01-05