CLINICAL EFFECT OF PRANAYAMA TECHNIQUES ON FASTING AND POST PRANDIAL BLOOD SUGAR: A RANDOMIZED CONTROL STUDY

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Abstract

Background: Various factors including modern lifestyle and increasing pace of life have given rise to a multitude of diseases of which type II diabetes seems to be the spearhead. While various medicines already exist for its treatment, the wisdom of traditional yogic exercises such as pranayama cannot be ignored. These exercises can be easily performed anywhere, anytime and by a subject of any age. Ease of performing them is one of the prime factors which lead this study. ***Aim:*** The aim was to determine the effect of 12-weeks pranayama techniques (breathing exercises) on fasting and post prandial blood sugar of male participants. ***Methodology***: For the purpose of the study, Total sixty (N=60) male participants of Department of Physical Education (T), Guru Nanak Dev University, Amritsar (Punjab) between the age group of 21-29 years were selected. The sixty subjects (N=60), were further assigned into two groups: Group-A: Experimental (n_1=30) and Group-B: Control (n_2= 30). ***Statistical analysis:*** Paired-samples t-test was used to compare the means of the pre-test and the post-test. The level of significance was set at 0.05. ***Results:*** The results show that there is insignificant difference between pre-test and post-test in fasting and post prandial blood sugar of experimental and control group with respect to pranayama techniques of male participants. Pranayama techniques may be recommended for a healthy lifestyle because it helps to decrease the chances of type –II diabetes, obesity and cardiovascular risk factors.

Keywords: pranayama, fasting blood sugar, post prandial blood sugar, type II diabetes.

Introduction

Due to high prevalence of type-II diabetes in young adults of India especially in urban areas, we felt the need to address the issue with pranayama techniques that already exist in Indian culture. Very few exercises take into account both physical and mental aspects of health. An exercise that should be as straining to body as it is relaxing to mind is pranayama. Pranayama is controlled breathing exercise which can be performed in isolation or paired with other stretching exercises called asanas. Main source of fuel to our body is oxygen and pranayama helps to increase capacity and efficiency of lungs to absorb oxygen. Further paired with other asanas it helps to make body a powerhouse of energy and balance which when applied properly can bring resonance in all phases of one's life. Of much interest, pranayama lowers the occurrence of obesity, hypertension, systemic inflammation, insulin resistance and type-II diabetes, hypertension, the metabolic syndrome, digestive disorders (including diverticular disease and cancers, higher blood cholesterol, and cardiovascular disease. As we know that diabetes is now a global epidemic and a worldwide healthcare challenge and according to many surveys; by 2025), the largest increases in diabetes occurrence will take place in developing countries.

Diabetes is the fourth foremost reason of global death by syndrome. Diabetes is presently affecting near about 246 million people worldwide and it will affect 380 million by 2025. In 2007, the top five countries with the largest total of diabetics were India (40.9

million), China (39.8 million), the United States (19.2 million), Russia (9.6 million) and Germany (7.4 million).In 2007, the five nations with the uppermost diabetes commonness in the adult population were Nauru (30.7%), United Arab Emirates (19.5%), Saudi Arabia (16.7%), Bahrain (15.2%), and Kuwait (14.4%) [McArdle et al., 2010]. In other words, diabetes mellitus cannot be cured but it can be controlled by other method such as walking, jogging, yoga and pranayama etc. [Leili et al., 2015].

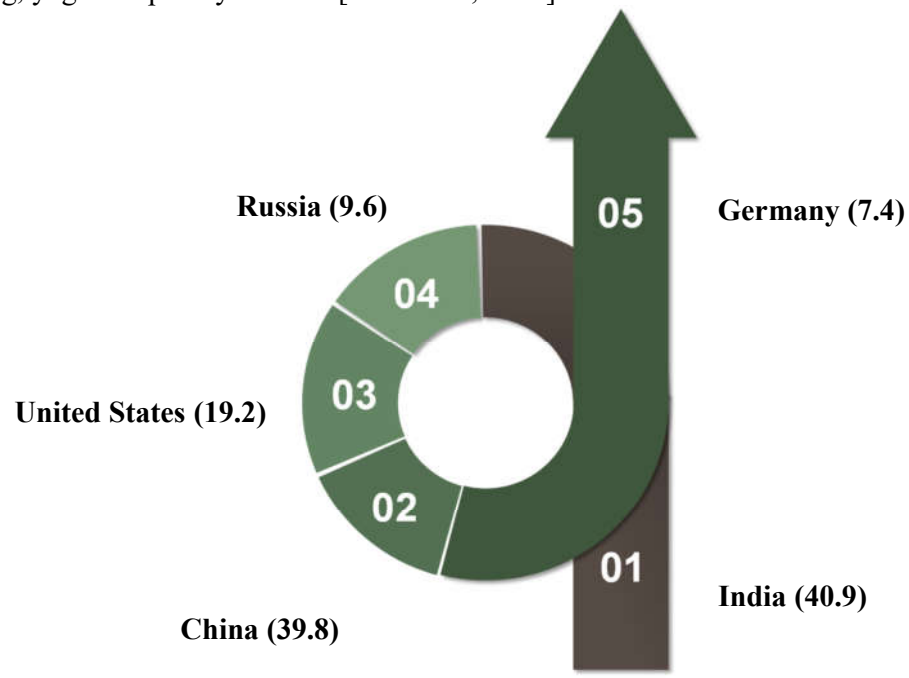

Fig. 1. The top five countries with the largest total of diabetics of the world.

According to WHO

The report of WHO (2014) says that burden of Non-communicable diseases (NCDs) and their risk factors such as death rate was 60% of all deaths in India. Out of all the NCDs major contribution to mortality is due to following four NCDs cardiovascular diseases (45%), chronic respiratory (22%), cancers (12%), diabetes (3%). Furthermore behavioural factors that are accountable for and under aggravate those conditions are tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol.

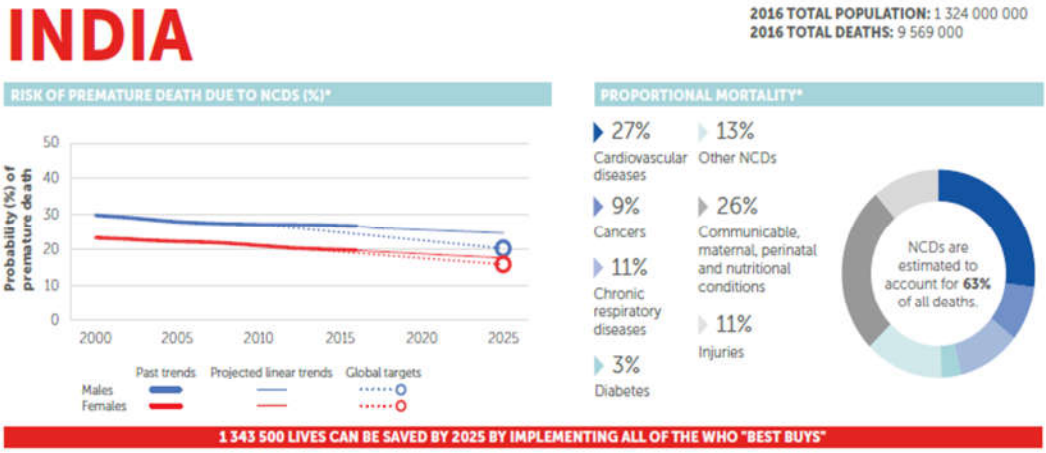

Fig. 2. World Health Organization - Noncommunicable Diseases (NCDs) Country Profiles, 2018.

Methodology

Subjects

Sixty male participants of Department of Physical Education (T), Guru Nanak Dev University, Amritsar between the age group of 21-29 years (Mean ± SD: age 23.78 ± 1.14 yrs, height 169.52 ± 5.44 cm, body mass 68.59 ± 10.03 kg) were selected. They were further assigned into two groups:

- Group-A: Experimental (n_1=30)
- Group-B: Control (n_2= 30)

Distribution and demographics of subjects are brought forth in Table 1.

Variables	Simple Size (N=60)		
	Total (N=60)	Experimental (n_1=30)	Control (n_2=30)
Age (yrs)	23.78 ± 1.14	23.73 ± 1.11	23.83 ± 1.18
Body Height (cm)	169.52 ± 5.44	169.50 ± 5.37	169.53 ± 5.60
Body Weight (kg)	68.59 ± 10.03	69.88 ± 9.81	67.29 ± 10.24

Design

The present study was a longitudinal (observational research method) follow-up study where the participants were selected using a convenience sampling technique i.e., participants were selected based on their availability to take part in the trial. Participants were assessed in two separate sessions pre and post.

Assessments

Baseline data of each participant for the fasting and post prandial blood sugar were measured in the laboratory of Health Centre, Guru Nanak Dev University, Amritsar (Punjab). Participants were evaluated two times throughout the study-pre-and post-test time.

Intervention

Sixty male participants of Department of Physical Education (T), Guru Nanak Dev University, Amritsar underwent Pranayama training program for 12-weeks; repeat assessments were performed on experimental group. There were no dropouts in the study.

Table 2. 12-weeks pranayama training for subjects.

12-weeks Pranayama Training			
Week	**Schedule**	**Execution Time**	**Volume**
1-4 Week	Preliminary Yogic Exercises	05 minute	35 minute
	Practice of Anuloma Viloma Pranayama Bhastrika Pranayama Kapal Bhati Pranayama Bhramari Pranayama (9X1 Set)	25 minute	
	Om chanting & breathing for relaxation	05 minute	
5-8 week	Preliminary Yogic Exercises	05 minute	45 minute
	Practice of Anuloma Viloma Pranayama Bhastrika Pranayama Kapal Bhati Pranayama Bhramari Pranayama (12X1 Set)	35 minute	
	Om chanting & breathing for relaxation	05 minute	
9-12 week	Preliminary Yogic Exercises	05 minute	55 minute
	Practice of Anuloma Viloma Pranayama Bhastrika Pranayama Kapal Bhati Pranayama Bhramari Pranayama (15X1 Set)	45 minute	
	Om chanting & breathing for relaxation	05 minute	

Statistical Technique

Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows version 16.0 software (SPSS Inc., Chicago, IL). Data is expressed as the mean ± SD. Student t test for paired samples was utilized to compare the means of the pre-test and the post-test. The level of significance was set at 0.05.

Results

The demographic and clinical characteristics of the fasting and post prandial blood sugar are presented in the following tables:

Table 3. Descriptive statistics (mean & standard deviation) and paired sample t-test of experimental and control group of fasting blood sugar of male participants.

Fasting Blood Sugar						
Group	**Number**	**Mean**	**Standard Deviation**	**Standard Error of the Mean**	**t-value**	***p*-value**
Experimental (Pre-test)	30	96.27	2.20	0.40	1.1721	0.2507
Experimental (Post-test)	30	95.70	2.59	0.47		
Control (Pre-test)	30	96.03	2.59	0.47	0.2523	0.8026
Control (Post-test)	30	96.13	2.22	0.41		

(a). Fasting Blood Sugar (Experimental Group)

A glance at Table 3 shows the Mean and Standard Deviation values of Fasting Blood Sugar of pre-test and post-test of experimental group of male participants was 96.27±2.20 and 95.70±2.59 respectively.

Insignificant differences were noted between pre-test and post-test in Fasting Blood Sugar since the calculated value of (t = 1.17) is less than tabulated value of $t_{0.05}$ (29) = 2.04 for the selected degree of freedom and level of significance. The data does suggest that the difference between pre-test and post-test of experimental group of male participants of Fasting Blood Sugar is insignificant. The t-test and p-value for the (Pre-Test & Post-Test) on the variable Fasting Blood Sugar has been presented graphically in Fig. 3.

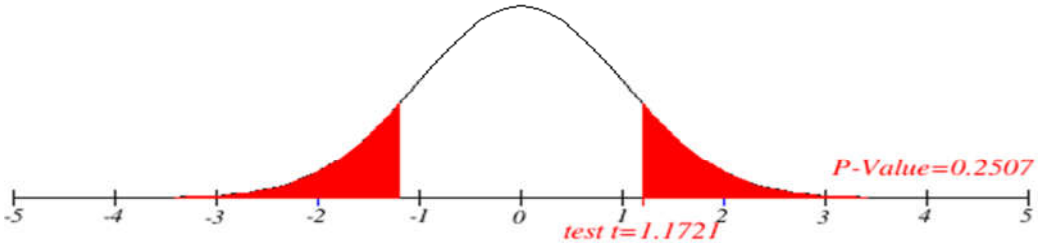

Fig. 3. t-test and p-value of (pre-test & post-test) of experimental group of male participants on the variable fasting blood sugar.

(b). Fasting Blood Sugar (Control Group)

A glance at Table 3 shows the Mean and Standard Deviation values of Fasting Blood Sugar of pre-test and post-test of control group of male participants was 96.03±2.59 and 96.13±2.22 respectively.

Insignificant differences were noted between pre-test and post-test in Fasting Blood Sugar since the calculated value of (t = 0.25) is less than tabulated value of $t_{0.05}$ (29) = 2.04 for the selected degree of freedom and level of significance. The data does suggest that the difference between pre-test and post-test of control group of male participants of Fasting Blood Sugar is insignificant. The t-test and p-value for the (Pre-Test & Post-Test) on the variable Fasting Blood Sugar has been presented graphically in Fig. 4 .

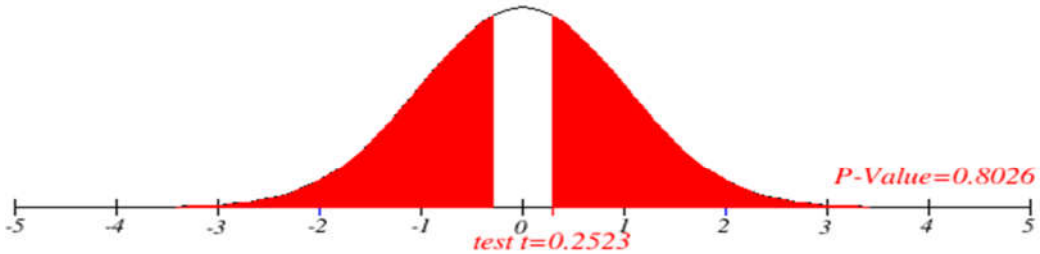

Fig. 4. t-test and p-value of (pre-test & post-test) of control group of male participants **on the variable fasting blood sugar.**

Table 4. Descriptive statistics (mean & standard deviation) and paired sample t-test of experimental and control group of post prandial blood sugar of male participants.

Post Prandial Blood Sugar						
Group	**Number**	**Mean**	**Standard Deviation**	**Standard Error of the Mean**	**t-value**	***p*-value**
Experimental (Pre-test)	30	129.47	7.55	1.38	1.4342	0.1622
Experimental (Post-test)	30	128.23	6.17	1.13		
Control (Pre-test)	30	128.13	9.61	1.75	0.6679	0.5095
Control (Post-test)	30	127.63	8.02	1.46		

(a). Post Prandial Blood Sugar (Experimental Group)

A glance at Table 4 shows the Mean and Standard Deviation values of Post Prandial Blood Sugar of pre-test and post-test of experimental group of male participants was 129.47±7.55 and 128.23±6.17 respectively.

Insignificant differences were noted between pre-test and post-test in Fasting Blood Sugar since the calculated value of (t = 1.43) is less than tabulated value of $t_{0.05}$ (29) = 2.04 for the selected degree of freedom and level of significance. The data does suggest that the difference between pre-test and post-test of experimental group of male participants of Post Prandial Blood Sugar is insignificant. The t-test and p-value for the (Pre-Test & Post-Test) on the variable Post Prandial Blood Sugar has been presented graphically in Fig. 5.

Fig. 5. t-test and p-value of (Pre-Test & Post-Test) of experimental group of male participants on the variable Post Prandial Blood Sugar.

(b). Post Prandial Blood Sugar (Control Group)

A glance at Table 4 shows the Mean and Standard Deviation values of Post Prandial Blood Sugar of pre-test and post-test of control group of male participants was 128.13±9.61 and 127.63±8.02 respectively.

Insignificant differences were noted between pre-test and post-test in Post Prandial Blood Sugar since the calculated value of (t = 0.66) is less than tabulated value of $t_{0.05}$ (29) = 2.04 for the selected degree of freedom and level of significance. The data does suggest that

the difference between pre-test and post-test of control group of male participants of Post Prandial Blood Sugar is insignificant. The t-test and p-value for the (Pre-Test & Post-Test) on the variable Post Prandial Blood Sugar has been presented graphically in Fig. 6.

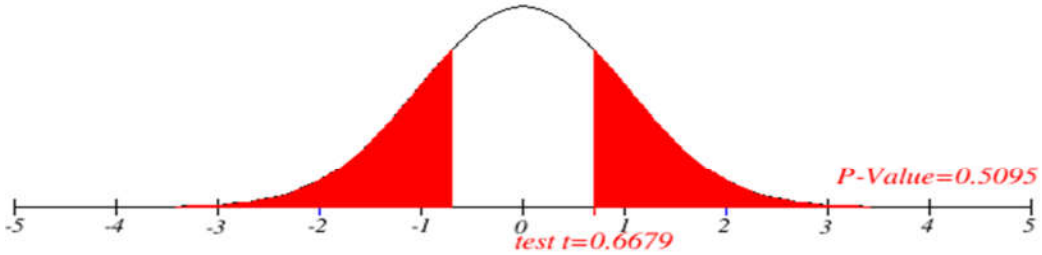

Fig. 6. t-test and p-value of (pre-test & post-test) of control group of male participants on the variable post prandial blood sugar.

Discussion

From the results it is evident that the 12-weeks pranayama training programme has shown insignificant difference in fasting and post prandial blood sugar of experimental and control group of male participants of Department of Physical Education (T), Guru Nanak Dev University, Amritsar (Punjab). Moreover this experimental study showed that there was also a decrease in fasting and posts prandial blood sugar [Chaya et al., 2008]. The findings are supported by the study conducted by [Manjunatha et al., 2005] titled "An investigation into the acute and long-term effects of selected yogic postures on fasting and postprandial glycemia and insulinemia in healthy young subjects". The results suggest that the performance of asanas led to increased sensitivity of the B cells of pancreas to the glucose signal. The increased sensitivity seems to be a constant change resulting from a progressive long-term effect of asanas. It also confirmed the decrease in blood glucose levels by yoga training and it is more effective than walking in reducing blood sugar levels. [Leili et al., 2015].

Anulom Vilom (alternate nostril breathing)

- The study is also supported by [Arkiath et al., 2018] who acknowledged that slow breathing technique in pranayama causes wide-ranging variations in the physiology of body by controlling the autonomic nervous system and also regularizes the rate of breathing and normalizes the heart rate and its inconsistency [Pal 2016].

Bhramari pranayama (humming bee breath)

- The research article shows that bhramari pranayama boosts the cerebral blood flow and oxygenation, thereby improving the neuronal activities of the brain centres, including those present in the limbic areas, hypothalamus, and medulla, as well as helpful in improving sympathovagal outflow [Pal 2016]. It calms the mind and could play a vigorous role in improving mental and physical state of health [Srivastava 2017].

Kapalbhati pranayama (forceful exhalations)

- The kapalbhati pranayama has a positive impact on borderline diabetic patients. Additionally, the study concluded that consistent training of kapalbhati pranayama has a healthy response for borderline diabetics by decreasing the blood sugar level [Bharathi et al., 2018].

Bhastrika pranayama (bellows breathing)

- The Sanskrit name Bhastrika means bellows and also acknowledged as breath of fire. This breathing exercise beneficial in the regulation of the pineal, pituitary, and adrenal glands, which play an significant role in the regulation of metabolism [Singh et al., 2009]

In short pranayama techniques have a positive effect on blood glucose and body weight. It is a lightweight exercise that can be performed at any level of physical fitness irrespective of age. In this study it has been found that regular pranayama decreases the blood sugar level so it may be recommended to subjects who are near to upper threshold of healthy blood sugar level. The study appreciates the practice of yogasana not only for diabetic patients and but also for numerous health conditions.

Conclusions

a. The outcomes of Table 3 shows that the values of Mean and Standard Deviation of pre-test and post-test of experimental and control group of fasting blood sugar of male participants are insignificant.
b. The outcomes of Table 4 shows that the values of Mean and Standard Deviation of pre-test and post-test of experimental and control group of post prandial blood sugar of male participants are insignificant.

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Conflict of interests

The authors declare that there is no conflict of interests.

References

1. Arkiath,V.R., Anjali, D., & Shashank, R.J. (2018). Therapeutic Role of Yoga in Type 2 Diabetes. *Endocrinol Metab (Seoul)*. 33(3), 307-317.
2. Bharathi, R., Preetha,S., & Jothi, P.(2018). Effect of Kapalbhati Pranayama in the blood sugar level in diabetic patients. *Drug Invention Today*. 10(11),2235-2237.
3. Chaya, M.S., Ramakrishan, G., Shastry, S., Kishore, R. P., & Nagarathna, R. (2008). Insulin sensitivity and cardiac autonomic function in young male practitioners of yoga. *Natl Med J India*. 21,215-6.
4. Datey, P., Hankey, A., & Nagendra, H.R.(2018). Combined Ayurveda and Yoga Practices for Newly Diagnosed Type 2 Diabetes Mellitus: A Conrolled Trial. *Complement Med Res*. 25(1),16-23.
5. Gokal, R., & Shillito, L. (2007). Positive impact of yoga and pranayam on obesity, hypertension, blood sugar, and cholesterol: A pilot assessment. *J Altern Complement Med*.13,1056–7.
6. Gurudut, P., & Rajan, A.P. (2017). Immediate effect of passive static stretching versus resistance exercises on postprandial blood sugar levels in type 2 diabetes mellitus: a randomized clinical trial. *J Exerc Rehabil*. 30 ,13(5),581-587.

7. Jain, S.C., Uppal, A., Bhatnagar, S.O., & Talukdar, B. (1993). A study of response pattern of non-insulin dependent diabetics to yoga therapy. *Diabetes Res Clin Pract Suppl*.19,69–74.
8. Khatri, D., Mathur, K.C., Gahlot, S., Jain, S., & Agarwal, R.P.(2007). Effects of yoga and meditation on clinical and biochemical parameters of metabolic syndrome. *Diabetes Res Clin Pract*. 78,9–10.
9. Leili, Y., Hamideh, A., Tahereh, S., & Mahya, R. (2015).The effect of walking and Yoga on Blood Glucose Levels in Type II Diabetes. *Int. J. Rev. Life. Sci*.5(9),1079-1084.
10. Malhotra, V., Singh, S., Tandon, O.P., & Sharma, S.B. (2005).The beneficial effect of yoga in diabetes. *Nepal Med Coll J*.7(2),145-7.
11. Manjunatha, S., Vempati, R.P., Ghosh, D., & Bijlani, R.L. (2005). An investigation into the acute and long-term effects of selected yogic postures on fasting and postprandial glycemia and insulinemia in healthy young subjects. *Indian J Physiol Pharmacol*. 49,319–24.
12. McArdle, D., Frank, I.K., & Victor, L. K. (2010). Exercise Physiology; nutrition, energy and human performance -7th ed. ISBN 987-0-7817-9781.
13. Pal, G. K. (2016). Efects of pranayama on cardiovascular health. Int J Clin Exp Physiol.3, 57-58.
14. Ramamoorthi, R., Gahreman, D., Skinner, T., & Moss, S. (2019). The effect of yoga practice on glycemic control and other health parameters in the prediabetic state: A systematic review and meta-analysis. *PLoS One*.16,14(10),e0221067.
15. Rossa, A., & Thomas, S. (2010). The health benefits of yoga and exercise, a review of comparison studies. *Alternative and complement medicine*. 16(1)3-12.
16. Sharma, R., Gupta, N., & Bijlani, R.L. (2008).Effect of yoga based lifestyle intervention on subjective well-being. *Indian J Physiol Pharmacol*.52,123–31.
17. Singh, R.B., Wilczynska, K.A., Fedacko, J., Pella, D., Meester, D.F. (2009). Pranayama: the power breath. Int J Disabil hum Dev. 8,141-153.
18. Singh, S., Malhotra, V., Singh, K.P., Madhu, S.V., & Tandon, O.P. (2004). Role of yoga in modifying certain cardiovascular functions in type 2 patients. *J Assoc Physicians India*.52,203-6.
19. Sinha, S.S., Jain, A.K., Tyagi, S., Gupta, S.K., & Mahajan, A.S. (2018). Effect of 6 Months o Meditation on Blood Sugar, Glycosylated hemoglobin and Insulin Levels in Patients of Coronary Artery Disease. *Int J Yoga*. 11(2):122-128.
20. Sreedevi, A., Gopalakrishnan, U.A., Kariassery, R. S., & Kamalamma, L.(2017). A Randomized controlled trial of the effect of yoga and peer support on glycaemic outcomes in women with type 2 diabetes mellitus: a feasibility study. *BMC Complement Altern Med*. 17(1),100.
21. Srivastava ,S., Goyal, P., Tiwari, S.K., & Patel. A.K. (2017). Interventional effect of Bhramari Pranayama on mental health among college students. *Int J Ind Psychol*.4,29-33.
22. V. V., Rathi, A., & Raghuram, N. (2017). Effect of short-term yoga-based lifestyle intervention on plasma glucose levels in individuals with diabetes and pre-diabetes in the community. *Diabetes Metab Syndr*. 11Suppl 2,S597-S599.

23. WHO. (2014). Burden of NCDs and their risk factors in India.

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