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RESEARCH ARTICLE

RODY STUDY (REVERSAL OF DIABETES BY YOGA STUDY): A SCIENTIFIC STUDY EVOLVING A SET PATTERN OF YOGA AND LIFE STYLE MODIFICATION IN DIABETIC PATIENTS

B. P. Agrawal[1*], D.K., C. Chauhan[2], Sangeeta Agrawal[3], Abhay P. Pandey[4], K. P. Singh[5], Virendra Singh[6], Anees F. Rizvi[7^] and Niraj Kumar[8]

[1]President, Institute of Applied Sciences (IASc), Allahabad, [2]Former Head, Dept. of Botany, Univ. of Allahabad Treasurer, IASc, [3]Hony. Scientist of IASc. [4] Assistant Professor, Deptt. of Statistics, Univ. of Allahabad, [5]Prof. Head, Dept. of Zoology, Univ. of Allahabad, Vice-President, IASc, [6] Yoga guru Patanjali, [7]Scientific Officer of IASc, [8]Secretary, IASc & Former Executive Secretary, The National Academy of Sciences, India, Prayagraj

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ABSTRACT

The rapid change in dietary patterns, physical inactivity, and increased body weight (especially the accumulation of abdominal fat), are some of the primary reasons for increased prevalence of diabetes among the Indian populace, especially in the adults above 40 yrs. There are several studies on different patterns of yoga, but with restrictions on diet, daily routine etc. The present study tried to find out the solution and evolve a fixed pattern of yoga beneficial for diabetic patients, with ease in adaptation. After trial, the set pattern of yoga was introduced and all clinical/haematological/anthropometric and ultrasonic tests were done. The findings supported that a set pattern of yoga, as evolved in this study is beneficial to the type-II diabetic patients to live almost normal and healthy life without much restrictions on diet and daily routine.

***Corresponding author:**
B. P. Agrawal

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INTRODUCTION

Our country Bharat (India) has become the Diabetic capital of world; the exponential rise of diabetes in India is mainly attributed to the changes in our lifestyle. The rapid change in physical activity and dietary patterns increases the body weight (especially the accumulation of abdominal fat), a primary reason for increased prevalence of hyperglycemic conditions. According to the International Diabetes Federation diabetes atlas (eighth edition, 2017), roughly 425 million people were there with diabetes, a figure that is projected to increase to 629 million by 2045 (1). India accounts for 17% of the total number of diabetes patients in the world. There are currently close to 80 million people with diabetes in India and this number is further expected to increase to 135 million by 2045 (Fig.-1). Diabetes Day (WDD), is observed on November 14 every year as an official United Nations Day since 2006; United Nations organizes a worldwide campaign, aiming to reach out to over 1 billion people in more than 160 countries. The objective of the global campaign is to draw international attention to the paramount issues related to the diabetic world (2). Dietary control and exercise are established treatment modalities in patients with type 2 diabetes and other lifestyle disorders, including obesity, hypertension, fatty liver (HAFLD) and dyslipidaemia. Urbanisation, the intake of calorie-rich food, modernization, less open space for exercise, and lack of motivation reduce the likelihood of adherence to dietary control and exercise. as a management. Moreover, individuals with diabetes have a reduced capacity to adapt to exercises, because of sedentary lifestyle, overweight, limited joint mobility, and other diabetes-related complications, including cardiovascular diseases, peripheral neuropathy, etc. Several studies have shown that poor adherence to diet and exercise programs were major limitations in the implementation of non-pharmacological treatments of diabetes (3). Yoga, which originated in India more than 5,000 years ago, aims at balancing and harmonizing the body, mind, and emotions (4). Increasing evidence suggests that yoga practice tackles the pathophysiologic mechanisms of diabetes and helps in controlling diabetes and its complications.

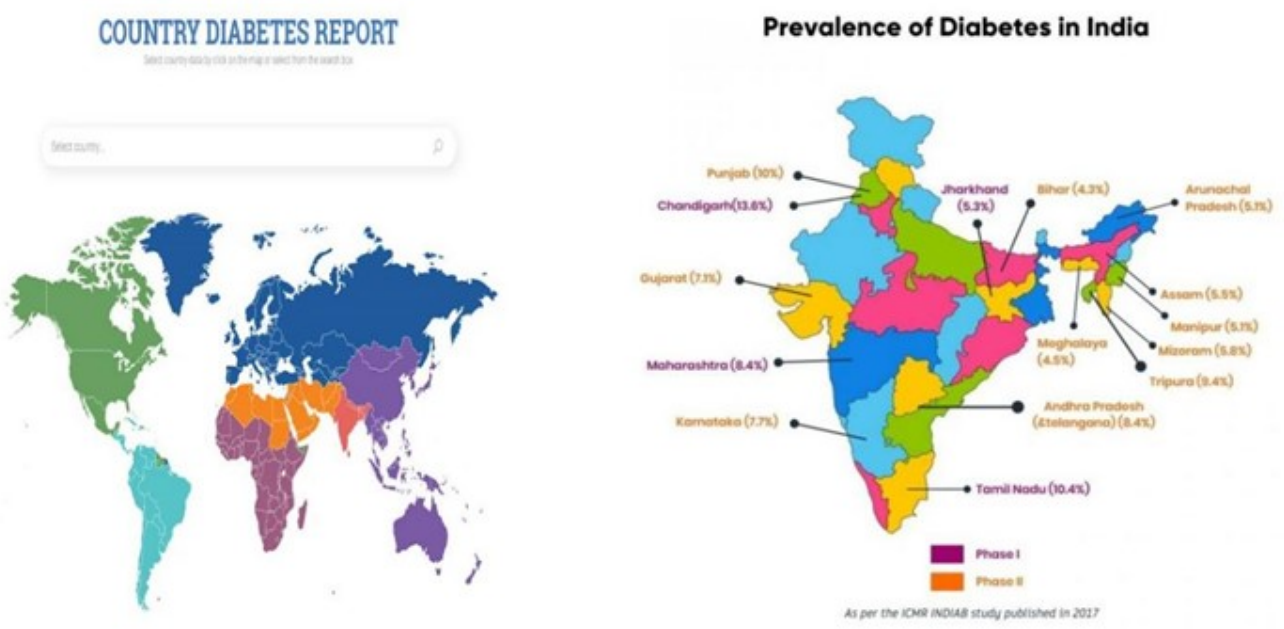

Fig.1. The maps showing status of diabetes in the World (courtesy: International Diabetes Federation. IDF diabetes atlas. 6th ed. Brussels, Belgium: International Diabetes Federation; 2013), and India

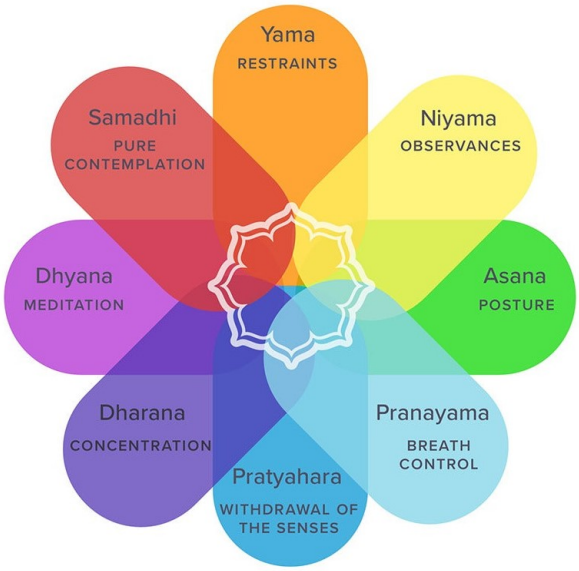

Fig. 2. Pictographic Description of Eight-limbed Path as depicted in Yoga-sutras, defined originally by Maharishi Patanjali (Ref: https://liforme.com/blogs/blog/the-real-truth-about-the-yoga-sutras-of-patanjali/)

Fig.3a: L) On set of Yoga under the supervision of a Yoga teacher, and an Allopathic Doctor; R) Yoga being practiced

Fig. 3b': Yoga being practiced in group during RODY Study

But, ironically, the practical evidences are very less from India, where the role of Yoga has been verified and certified by the scientists as well as the allopathic doctors; as well a certain regime of a set pattern of yoga has never been clinically verified which could be defined/prescribed as a set pattern, authentically tested for adoption by the type-II diabetic patients. Therefore, it was decided by a group of scientists, including the specialists from ethno-medicine, alternative medicine and allopathic medicine, to devise a mechanism/protocol to experimentally gather evidences on the efficacy of set pattern of Yoga in controlling/reversal of diabetes among a group of volunteers (Type 2 Diabetic patients).

METHODOLOGY

Yoga practice is a complex intervention with various components, including cleansing processes (kriya), postures (asana), controlled breathing (pranayama), meditation, relaxation, chanting mantras, yogic diet, code of conduct, philosophy, and spirituality. Patanjali's explanation of an eight-limbed (the Sanskrit word is *ashtanga*) path is the part of the *Yoga Sutras* that is most prevalent in modern practice. The description of the eight limbs is a very small section, comprising just 31 out of the 195 verses (Fig. -2). Many yoga practices have been found to be beneficial in the management of type 2 diabetes (5); however, their judicious use is recommended after a careful assessment of a patient's overall health, individual requirements, associated risk factors, and contraindications. 20 volunteers (with Type 2 diabetic conditions) of different age groups (30-70 yrs) were selected for the practice of a set pattern of Yoga, and their diabetic management for 90 regular days under the vigilant supervision of a Yoga teacher (Guru), and an Allopathic doctor; further, ethical clearance was also taken. By considering the person as a whole, including physical inactivity and poor health, yoga practices of high or low intensity were prescribed, by Yoga teacher. Accordingly, the following pattern of Yoga practices were introduced –

A)Preparatory practices/warming up: *Surya Namaskar (*different standing postures as depicted in Yoga-sutras, further practically demonstrated by a Yoga-guru*):* Slow speed, 5–15 rounds according to an individual's capacity; 5–10 minutes

B) Pranayams:*1. Kapal Bhati (*fast pace respiratory exercise*), 2. Anulom-Vilom* (alternate nostril breathing); Every day for 10-15 min. each. *3. Bhramari* (humming bee breath), for 3 min. only; and before these recitations of '*OM (A-U-M)',* 3-5 min.

C) Asanas: *1. Vakrasan (*spinal twist): Recommended to hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute, 2. *Mandukasan* (frog pose), 3. *Pavanmuktasan* (wind releasing pose), 4. *Bhujangasan* (cobra pose), 5. *Dhanurasan* (bow pose), 6. *Naukasan* (boat pose), 7. *Shavasan* (corpse pose): Recommended to hold the final pose for 15 seconds, gradually increasing the duration up to 1 minute (Fig.-3a &b) Further, as per advice of allopathic doctor, the haematological tests were done before the onset of yoga schedule, and also weekly or on regular intervals as per regime/demand of the project/therapy to maintain health and necessary medical interventions; and these were analysed on the basis of standard statistical interpretations as follows

Repeated Measurements- Analysis of Variance (RM-ANOVA): A repeated measurements analysis of variance (RM-ANOVA) is carried out in order to ascertain whether or not there is a difference that can be considered statistically significant between the round of the measurement in which the identical subjects appear in each round. RM- ANOVA uses the following null and alternative hypothesis:

The null hypothesis (H_0): $\mu_1 = \mu_2 = \mu_3 = \cdots = \mu_n$ (the population means of all the round are equal) The alternative hypothesis (H_a): At least two population means are different) The details of the anthropometric and hematological examinations made, are as follows-

Body Mass Index (BMI): The BMI (Kg/m^2) is a convenient rule of thumb used to broadly categorize a person as based on tissue mass (muscle, fat, and bone) and height (6). On the onset of the study, the BMIs of all the volunteers were calculated and recorded; further observations were made on 15^{th}, 45^{th}, 75^{th} and 90^{th} days. The record was statistically verified in the end of the study, applying ANOVA.

Waist Circumference (WC): To measure central obesity, waist circumference (WC in centimeter) appears to be a better indicator than BMI and waist-to-hip ratio. WC measurement is convenient, and it is more strongly correlated with intra-abdominal fat content (7 to 10). The World Health Organization and the International Diabetes Federation (IDF) suggest measuring WC in the horizontal plane midway between the lowest ribs and the iliac crest (WC-mid). On the onset of the study, the WCs of all the volunteers were calculated and recorded; further observations were made on 15^{th}, 45^{th}, 75^{th} and 90^{th} days. The record was statistically verified in the end of the study, applying ANOVA.

Random Blood Sugar (RBS): A random glucose (millimoles per liter) test is one method for measuring the amount of glucose or sugar circulating in a person's blood at any time of day (11). This was performed for each diabetic person (volunteer) on 15^{th}, 45^{th}, 75^{th} and 90^{th} days, by electronic machine Accu-Chek Extra Care, Roche Diabetes Care India Pvt Ltd. The results were analysed statistically.

HbA1c: It is a blood test that is used to diagnose type 2 diabetes. HbA1c (mmol/mol)is short for glycated haemoglobin. Haemoglobin (Hb) is the protein in red blood cells that carries oxygen through our body. HbA1c refers to glucose and haemoglobin joined together (the haemoglobin is 'glycated'). The amount of HbA1c formed is directly related to the amount of glucose in our blood (12).

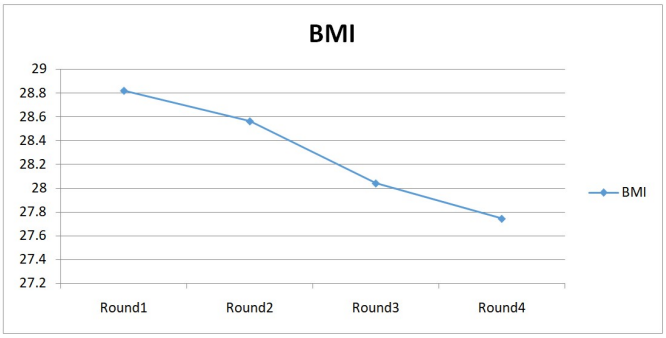

Fig. 4. Graph showing average reduction in BMI status of the volunteers

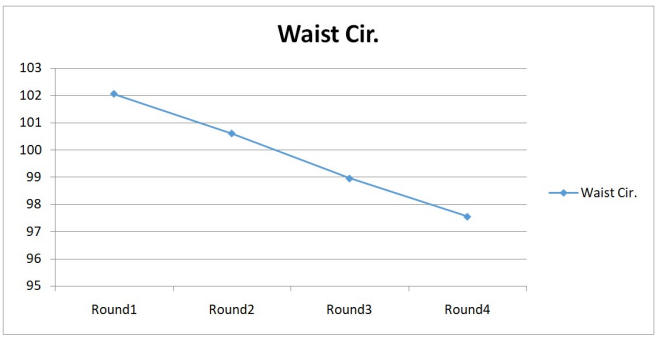

Fig. 5. Graph showing average reduction in WC of the volunteers

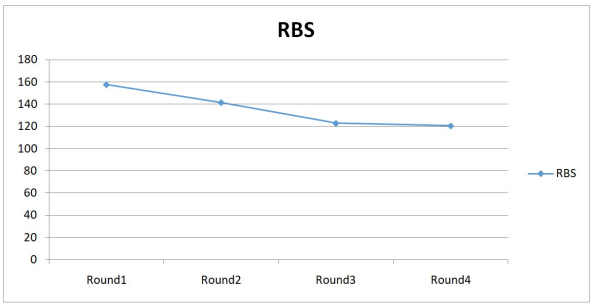

Fig. 6. Graph showing average reduction in RBS of the volunteers

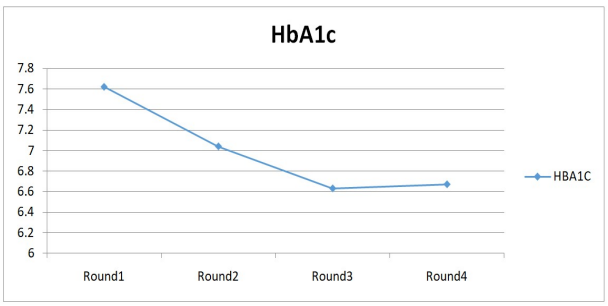

Fig. 7. Graph showing average reduction in HbA1c of the volunteers

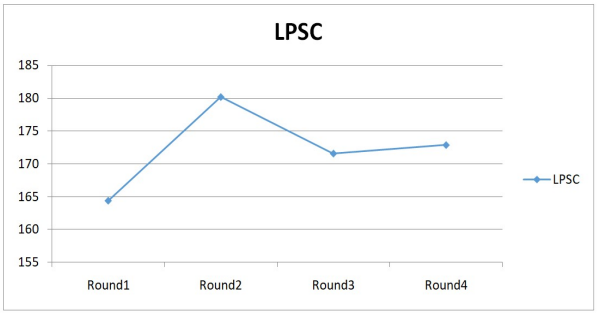

Fig. 8 a. Graph showing average value of the Serum Cholesterol of the volunteers

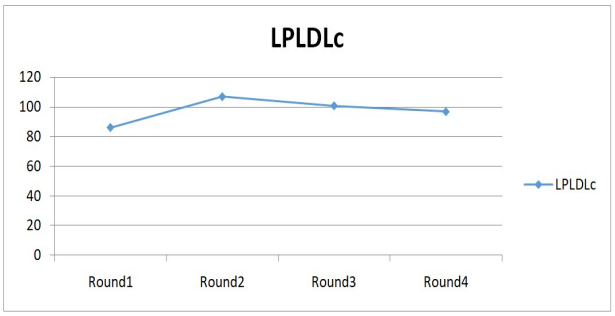

Fig. 8 b. Graph showing average value of the LPLDLc of the volunteers

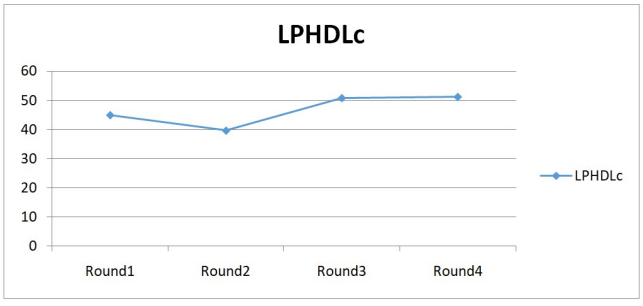

Fig. 8 c – Graph showing average value of the LPHDLc of the volunteers

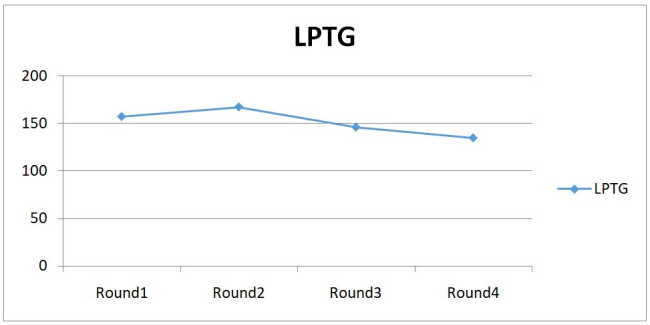

Fig. 8 d – Graph showing average value of the Triglycerides of the volunteers

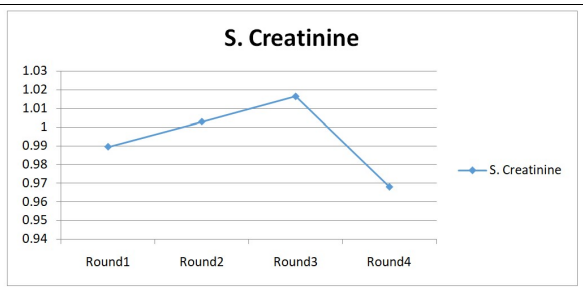

Fig. 9 – Graph showing average value of the Serum Creatinine of the volunteers

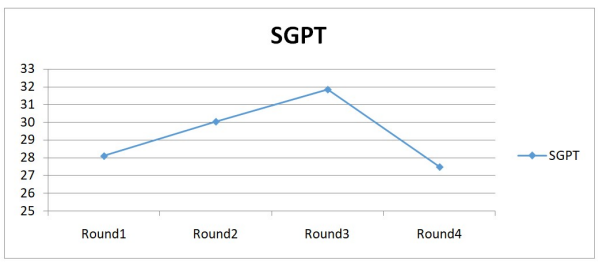

Fig. 10. Graph showing average value of the SGPT of the volunteers

Ion-exchange HPLC was applied, as it is better in terms of identification of the presence of different genetic variants like S, C, E and D in their heterozygous state (13). HbA1c of all the volunteers were calculated and recorded on 15th, 45th, 75th and 90th days. The record was statistically analysed.

***Lipid Profile Tests (*mg/dl):** Cholesterol, triglyceride, phospholipids, and proteins (known as apolipoproteins) are carried in plasma on generally spherical lipoprotein particles. Lipoproteins carry phospholipid, free cholesterol, and apolipoproteins on the surface, and triglyceride and cholsteryl ester in their core. The lipid panel analyses our blood to measure different types of lipids:

Total cholesterol: This measures our overall cholesterol level. Low-density lipoprotein (LDL) cholesterol: This type of cholesterol, known as "bad cholesterol," can collect in blood vessels and increase our risk of cardiovascular disease. High-density lipoprotein (HDL) cholesterol: This type of "good cholesterol" helps reduce the build-up of cholesterol. Triglycerides: Excess amounts of this type of fat are associated with cardiovascular disease and pancreatic inflammation. Therefore, all these tests were also performed in a reputed path-lab, using preparative ultracentrifuge method (14), for estimation of different range of the lipids, on 15th, 45th, 75th and 90th days of the study; analysed further statistically.

Serum Urea: A common blood test, the blood urea nitrogen (BUN in mg/dl) test reveals important information about how well our kidneys are working. A BUN test measures the amount of urea nitrogen that's in our blood (15). The tests were performed in a reputed laboratory on regular interval of 15th, 45th, 75th and 90th days; further statistical analysis were done.

Serum Uric Acid: Uric acid (mg/dl) is the final product of purine metabolism in humans. Measurement of uric acid concentration in the blood is performed (method developed by Town, et. al., and modified by Siedel) to aid in the diagnosis and treatment of many renal and metabolic disorders, including diabetes (16). The tests were performed in a reputed laboratory on regular interval of 15th, 45th, 75th and 90th days; further statistical analysis were done.

Serum Creatinine:(mg/dl): It was also necessary to estimate the function of the kidney, as well as to rule out any metabolic disorder; following the Enzymatic Method (17), the tests were performed on regular interval of 15th, 45th, 75th and 90th days; further statistical analysis was done.

SGPT: Serum Glutamic Pyruvic Transaminase (SGPT, in per liter), is a test that gauges the condition of our liver. The SGPT test analyses the blood level of SGPT, a liver enzyme. ALT, or Alanine Aminotransferase, is another name for SGPT (18); the tests were performed on 15th, 45th, 75th and 90th days; statistical analysis was also done. Further, just before the onset and at the end of the study, the whole abdomen Ultrasound, Electrocardiogram (ECG) and Homeostatic Model Assessment Index Insulin Resistance (HOMA-IR), eye fundoscopy tests were done in the clinic/path-lab of reputed allopathic doctors, to finally observe the status of the vital organs before & after the study, so that medico-scientific correlations could be established for definite inferences.

RESULTS AND DISCUSSION

As described earlier, all the volunteers were diabetic (type-II); and their glycemic index varied to a large extent; therefore, a pattern of simple & adaptable yoga-regime was prescribed for 90 days by the yoga-teacher and regular observations were made on their practice of yoga & physio-metabolic status. Everyone adapted to the yoga regime, within 15 days. As *Surya Namaskar* became a traditional blend of the practice of two different systems such as physical culture and *Yoga* and thus it heads out to be the forerunner practice of modern-day physical exercises (19). It is evident from earlier studies (20-22) that *Surya Namaskar* works not only at physical and physiological levels but also at the psychic levels. It improves the metabolic functioning of the body and regulates the secretions of the glands; therefore, it is clear that the practice of *Surya Namaskar* helps in keeping the mental health and the equilibrium of the state of mind. Further, a brief chanting of OM (5 min) might enhance parasympathetic nervous system activity, promote relaxation, and provide calmness (23). Therefore, *Surya Namaskar* & chanting of OM were introduced as precursor, in daily practice followed by *Pranayams*, as *1. Kapal Bhati (*fast pace respiratory exercise)*, 2. Anulom-Vilom* (alternate nostril breathing) and *3. Bhramari* (humming bee breath); and seven *Asanas*, as *1. Vakrasan (*spinal twist), 2. *Mandukasan* (frog pose), 3. *Pavanmuktasan* (wind releasing pose), 4. *Bhujangasan* (cobra pose), 5. *Dhanurasan* (bow pose), 6. *Naukasan* (boat pose) and 7. *Shavasan* (corpse pose).

The aforesaid *Pranayams* and *Asanas* were selected on the basis of their cumulative effect on man's health, which is already well established. *Anulom vilom* has been shown to yield significant improvements in components of health-related fitness (i.e., cardiorespiratory endurance, oxygen exchange at alveoli level, flexibility, and percentage of body fat); and the vibrations created in *bhramari* have a soothing and calming effect on the mind and could play a vital role in improving mental and physical health (24 & 25). Less oxygen supply is the main cause of all diseases. On the other hand, Kapalabhati pranayama practice rejuvenates dormant cells of lever, pancreases (βcells), spleen, kidney and intestine: and it is also beneficial on the pulmonary functsion (26). Thus all above Pranayams prepare an individual for smooth adaptation of Yoga-practices, specially the Asanas, as well as enhance the cardiorespiratory endurance, flexibility and mental and physical health. Further, effect of aforesaid Asanas has also been discussed in several earlier findings, especially by Arkiath Veettil Raveendran*et.al.* (3), Manjunatha S. *et.al.* (27), Mullur R .S. *et.al.* (28) and others. Another study showed that yoga postures had a positive effect on glucose utilization and fat redistribution in individuals with type 2 diabetes (29).

Thus, the aforesaid yoga practice regime (type, duration & frequency of the set pattern) prescribed by the Yoga-teacher was authentic, as also tested & described earlier in many studies (30, 31, 32); but the focus of the present study was to evolve and establish a definite pattern/regime of these practices which could reverse the diabetic disorder in chronic type-II patients without forcing them to reduce their dietary intake or changing their daily routine (except practicing yoga).

The results of clinical tests/observations made are as

BMI: From the onset to the finish, a steady decrease was recorded in the average BMI (kg/m2) of the volunteers (Fig. 4). A repeated-measures ANOVA determined that mean BMI scores differed significantly across four time points ($F(1.603, 30.461) = 15.613$, $p =<0.001$). A post hoc pairwise comparison using the Bonferroni correction showed a decreased BMI score

Table 1. Result of anti-hyper glycemic drugs before and after definite pattern/regime of the set practices of yoga, among diabetic disorder in chronic type-II patients

S.N.	Age / Sex	ANTI HYPER GLYCEMIC DRUGS		HBA1C GM%	
		ON ENTRY	ON EXIT	ON ENTRY	ON EXIT
1	48/ M	*Glimepiride1mg *Metformin1000mg	*Nil	8.7	4.8
2	52/ M	*Glimepiride4mg *Metformin1000mg *Dapaglifozin10mg *Teneligliptin20mg	*Glimepiride1.5mg *Metformin500mg	8.6	5.4
3	56/ M	*Glimepiride1mg *Metformin1000mg	*Metformin500mg	6.6	5.2
4	71/ M	*Dapaglifozin10mg *Metformin1000mg	*Dapaglifozin10mg *Metformin1000mg	6.1	-
5	54/ M	*Glimepiride1mg *Metformin500mg	*Metformin500mg	7.3	6.8
6	58/ M	*Glimepiride1mg *Metformin500mg *Vildagliptin100mg *Dapaglifozin10mg	*Glimepiride.5mg *Metformin250mg *Dapaglifozin10mg	6.4	6.1
7	53/ F	*Glimepiride1mg *Metformin500mg	*Glimepiride.5mg *Metformin250mg	5.8	6.9
8	52/ M	*Glimepiride4mg *Metformin2000mg *Dapaglifozin10mg *Sitagliptin100 mg	*Glimepiride2mg *Metformin1500mg *Dapaglifozin10mg *Sitagliptin100 mg	10.0	8.4
9	63/ M	*Glimepiride2mg *Metformin500mg *Pioglitazone15mg	*Glimepiride1mg *Metformin250mg *Pioglitazone7.5mg	10.7	10.7
10	38/ F	*Metformin1000mg	*Nil	6.8	6.4
11	59/ M	*Glimepiride1mg *Metformin500mg *Dapaglifozin10mg *Sitagliptin100 mg	*Metformin500mg *Dapaglifozin10mg *Sitagliptin100 mg	-	-
12	68/ M	*Glimepiride.5mg *Metformin250mg	*Glimepiride.5mg *Metformin250mg	9.4	7.9
13	45/ M	*Glimepiride4mg *Metformin1000mg *Dapaglifozin10mg *Sitagliptin100 mg *Pioglitazone15mg	*Glimepiride4mg *Metformin1000mg *Dapaglifozin10mg *Sitagliptin100 mg *Pioglitazone15mg	10.1	4.1
14	57/ M	*Glimepiride2mg *Metformin1000mg *Teneligliptin20mg *Dapaglifozin10mg	*Glimepiride2mg *Metformin1000mg *Teneligliptin20mg *Dapaglifozin10mg	8.4	7.7
15	45/ M	*Teneligliptin20mg *Metformin500mg	*Teneligliptin20mg *Metformin500mg	5.8	5.8
16	54/ F	*Glimepiride3mg *Metformin500mg *Teneligliptin20mg *Pioglitazone15mg *Empaglifozin25mg	*Glimepiride2mg *Metformin500mg *Teneligliptin20mg *Pioglitazone15mg *Empaglifozin25mg	7.0	6.5
17	67/ F	*Metformin1000mg	*Nil	5.4	5.0
18	32/F	*Metformin500mg *Dapaglifozin5mg *Sitagliptin50 mg *Mathunashini2 Tab *Mathugrit2Tab	*NIL	10.4	7.2
19	50/ M	Aurvedic Medicines	*NIL	11.4	7.1
20	67/ M	*NIL	*NIL	5.8	5.6

between the initial assessment at 15th day and follow-up assessment after 45th, 75th, and 90th day. However, the decrease in BMI score did reach significance when comparing the initial assessment to a second follow-up assessment taken after 45th, 75th, and 90th day. Therefore, we can conclude that the results for the ANOVA indicate a significant time effect. This general correlation is particularly useful for consensus data regarding obesity or various other conditions because it can be used to build a semi-accurate representation from which a solution can be stipulated; the cross-sectional studies indicated that sedentary people can decrease BMI by becoming more physically active (33).

Therefore, in consonance with earlier findings (34 & 35), the present yoga-regime supports that being active by practicing regular yoga is helpful in reducing BMI, thus helping maintenance of glycemic index, as discussed by Kosuri M, *et.al.* (36), and many others.

WC: There was drastic fall (Fig. -5) in waist circumference recorded from the initial measurements to the final status. RM-ANOVA results ($F(1.477, 28.070) = 27.537$, $p =<0.001$) shows that mean difference is significant at the .05 level . It has already been established in earlier works that the adipose tissue

accumulation around the waist, is directly related to the obesity, diabetes and other diseases (37); also a positive effect has been found in decreasing glycemic index by reducing the waist circumference (38, 39).

Random Blood Sugar (RBS): The below graph (Fig.-6) depicts clearly that the average RBS of the group decreased in first two months, but later on stabilized gradually. RM-ANOVA results ($F(1.639, 31.147) = 3.907$, $p < 0.05$) shows that mean difference is significant at the .05 level . The effect of yoga on RBS has been discussed by many (40, 41); but the point of interest in the present study is stabilising the RBS level after two months, which points out towards the fixation pattern due to the yoga-regime, not found in any other studies.

HbA1c: A gradual decrease in group HbA1c was recorded by the second month (Fig.-7), which enhanced a little by the end of 3rd month; which is statistically significant with RM-ANOVA results ($F(2.176, 41.340) = 3.849$, $p < 0.05$) shows that mean difference is significant at the .05 level. Except the two patients, the HbA1c decreased even at the end of the third month; and after discussion it was found that they could not stick to the prescribed medicines properly during the third month due to their sudden over busy schedule. But overall reduction in HbA1c supports that yoga is effective in management of HbA1c, as described earlier by others also (42, 43, 44). The above results are also verified in terms of HOMA-IR, while assets that the Yoga helped in reducing the Insulin resistance, which is a common factor in all constituents of metabolic syndrome.

Lipid Profile Tests: The graphs in (Figs. 8 a, b, c & d,) show the trends (increasing/decreasing) of the different indices of the lipid profile of the group, as Serum Cholesterol, Low-density lipoprotein (LDL) cholesterol, High-density lipoprotein (HDL) cholesterol and Triglycerides, respectively. It was observed that the low density cholesterol of the group decreased by the end of third month, while high density cholesterol increased; total cholesterol and triglycerides also decreased, but due to two patients irregular medication, the group behaviour for these two parameters could not be found significant. As the time span was too short therefore, it didn't affect the readings of cholesterol density, as reported in other studies (45); however, the present study is in consonance with the earlier findings regarding overall status of the lipid density, as described by others (46, 47, 48). RM- ANOVA results ($F(2.490, 47.307) = 1.661$, $p > 0.05$) shows that mean difference of LPSC is non-significant at the .05 level. RM- ANOVA result ($F(2.214, 42.059) = 3.970$, $p < 0.05$) provides significant result over the round of measurements for LPLDLc at the .05 level. RM- ANOVA result ($F(2.460, 46.735) = 29.892$, $p < 0.05$) provides significant result over the round of measurements for LPHDLc at the .05 level. RM- ANOVA result ($F(2.068, 39.285) = 2.285$, $p < 0.05$) provides non-significant result over the round of measurements for LPTG at the .05 level. Serum Urea and Uric Acid tests were also done; but there was some error reported in a few samples, hence not included in observations.

Serum Creatinine: There was a gradual increase in Serum Creatinine from the 15th day to the next follow up at 45th and 75th day but at 90th day its decreased rapidly (Fig.-9); the statistical findings depicted non-significant result of RM-ANOVA ($F(2.490, 47.307) = 1.661$, $p > 0.05$). The gradual increase was due to the rigorous yoga which burnt the muscle mass to optimise the energy requirements of the body; but after acclimatization, the steady decrease was observed to attain stability. These findings support that even the excess of muscular weight is lost to maintain the overall weight and vigour, by regular yoga; in consonance with the other studies (49, 50).

SGPT: There was a gradual increase in SGPT from 15th day to next follow up at 45th and 75th day but at 90th day it decreased rapidly (Fig.-10); the statistical findings depicted non-significant result of RM- ANOVA ($F(2.123, 40.343) = 2.195$, $p > 0.05$). The gradual increase was within the normal range, it happened due to increased food intake, and the sluggish liver metabolism took almost two months to become active; but after adaptation of a set pattern of yoga regime, the patients food intake stabilised, the excess fat melted within first two months, and the liver was activated by the third month functioning properly. Therefore, the SGPT came down to ideal level almost in all the subjects. It is as per observations made in earlier studies (51, 52). Not only that, the whole abdomen Ultrasound tests done in the end also supported the findings as there was marked reduction in the fatty liver grade of the group.

CONCLUSION

In the end when the medicine doses were analysed and compared from the first to last month (Table 1), it was found that there was a marked reduction of the medicine/it's doses among all the patients/volunteers; further their food intake & energy utilization improved by the end of the study improving the BMI & WC. The cardiogram of all were normal; and everybody reported feeling energetic and agile. The comparison of HOMA-IR with the Ultrasonic study of liver depicts that there was a significant decrease in grade of fatty liver. Therefore, above recommends that NAFLD be included as part of metabolic syndrome. The reports/observations were discussed with other doctors of the city before taking further steps to simulate the data. Thus, the present study successfully established a definite pattern/regime of the set practices of yoga, which could reverse the diabetic disorder in chronic type-II patients without forcing them to reduce their dietary intake or changing their daily routine (except practicing yoga). Therefore, a similar study may be done for Type -I diabetic patients to verify the effects of the set pattern of Yoga at lifestyle modification for the treatment of diabetes.

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Glossary of Abbreviations

BMI: *Body Mass Index*
ECG: Electrocardiogram
HAFLD: Hypertension, fatty liver and dyslipidaemia

HbA1c: Glycated haemoglobin
HDL: High-density lipoprotein
HOMA-IR: Homeostasis model assessment-estimated insulin resistance
LDL: Low-density lipoprotein
LPLDLc: Lipoprotein low density lipid cholesterol
LPSC: Lipoprotein Serum Cholesterol
LPTG: Lipoprotein triglycerides
Kg/M: Kilogram per meter
NAFLD: Nonalcoholic fatty liver disease
RBS: Random Blood Sugar
SGPT: Serum Glutamic Pyruvic Transaminase
WC: Waist Circumference
WDD: World Diabetes Day

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