

# EFFECTIVENESS OF PHYSIOTHERAPY AND YOGA ON REACTION TIME, METABOLIC MARKERS, AND WELLNESS SCORE IN POSTMENOPAUSAL DIABETIC WOMEN

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## Abstract

**Background:** Yogic practices have been found to be beneficial for overall health and well-being, and they can potentially play a supportive role in the prevention and management of diabetes mellitus (DM) as well as reduce cardiovascular complications. While it is important to note that yoga should not be considered a standalone treatment for diabetes, it can be a complementary approach that can be incorporated into a comprehensive treatment plan. This study assessed the reaction time, metabolic markers, and wellness score of postmenopausal diabetes patients to compare the benefits of yoga and therapy. **Methodology:** The study recruited 15 female patients aged 36 to 63 years who were receiving medical treatment for type 2 DM at AIMSRS. The patients were selected using an accidental sampling method. All participants provided informed consent to participate in the study. Among the recruited patients, 11 were post-menopausal for more than a year, and 4 were peri-menopausal. The study design was pre and post intervention design to assess any changes in reaction time, biochemical markers and subjective wellbeing **Results:** The statistical analysis in the study used the Student's t-test for paired samples. By using the paired t-test and accepting p-values less than 0.05 as statistically significant, the study aimed to determine if there were significant differences in the measured parameters before and after the intervention. The study findings suggest that yoga training resulted in a decrease in ART and VRT in both the right and left hands. However, the decrease in reaction time was statistically significant ( $P=0.0357$ ) only for the ART from the right hand. Specifically, the ART decreased from an average of  $196.87 \pm 9.25$  milliseconds to  $178.04 \pm 6.36$  milliseconds after the yoga training program. FBG decreased significantly ( $P=0.0035$ ) by 20.62%, PPBG also decreased significantly ( $P=0.0012$ ) by 14.52%, HDL increased significantly ( $P=0.022$ ). There was a significant ( $P=0.003$ ) decrease of 17.37% in TC/HDL ratio and also significant ( $P=0.016$ ) increase of 19.13% in the HDL/LDL ratio. **Conclusion:** In postmenopausal diabetes, a six-week yoga and physical therapy training program improves lipid profiles, blood sugar levels, and response times. Incorporating a comprehensive yoga and physical therapy treatment program into a successful complementary or integrative therapy program may improve the standard medical care for DM

**Keywords:** Yoga and Physical Therapy; Postmenopausal Diabetic Women; Diabetes Mellitus (DM), ACYTER, Metabolic Markers.

## INTRODUCTION

Numerous scientific studies demonstrate the benefits of yoga and physical therapy for maintaining health and treating psychosomatic diseases. Yoga and physical therapy's scientific foundation modifies the physiology of the body [1]. Adjustments to one's yogic lifestyle assist prevent and manage lifestyle disorders. Diabetes mellitus is a psychosomatic and lifestyle condition caused by sedentary behavior, physical, emotional, and mental stress. Modern study has focused on the psychophysiological effects of yoga and physical therapy as it transcends physical therapy. Yoga and physical therapy therapies reduce body weight, blood pressure, glucose levels, and high cholesterol, according to a systematic study conducted between 1980 and 2007[2]. The systematic review which included 32 articles published between 1980 and 2007, found that yoga interventions were generally effective in reducing body

weight, blood pressure, glucose levels, and high cholesterol [10]. This indicates that yoga may have a beneficial role in improving these important risk factors for cardiovascular disease and diabetes.

Physical therapy and yoga can lower hypertension, dyslipidemia, and diabetes. Yoga and physical therapy enhance insulin sensitivity and diminish the correlation between body weight and insulin sensitivity with long-term practice. Yoga and physical therapy are safe, simple to learn, and accessible to everyone, even the ill, old, and disabled, with no negative side effects and several advantages. It is a simple, inexpensive, and safe adjuvant for DM patients.

Yoga and physical therapy can prevent and treat cardiovascular issues in patients with non-insulin-dependent diabetic mellitus (NIDDM). During menopause, ovarian function diminishes, resulting in altered lipoprotein profiles, altered glucose and insulin metabolism, and a risk of cardiovascular disease [3].

The main objective of this study is to evaluate the impact of a six-week yoga and physical therapy program on the wellness score, metabolic indicators, and reaction time of postmenopausal diabetes patients.

## METHODOLOGY

The present study conducted at the Department of Physiotherapy at Apollo Medical College in Hyderabad. The study was conducted over a period of one year and was approved by the Institutional Ethics Committee, [EC/AIMSR/1528] indicating that ethical standards were followed in the study. The subjects enrolled in the study were outpatients from the Department of Gynaecology and Obstetrics at Apollo Medical College, and they were those who volunteered to join the study.

At the Apollo College of Physiotherapy in Hyderabad, 15 female patients with type 2 DM were randomly selected and consented to take part in this study. Yoga and physical therapy were new to the patients. Four were post-menopausal and eleven were menopausal. Neurological, hypertensive, and musculoskeletal problems affected four of the subjects. Patients who had a history of nephrologic or ophthalmologic problems were not included in the study.

Among the factors evaluated both prior to and after the six-week trial were Reaction Time (RT), a biochemical experiment, a wellbeing questionnaire, yoga, and a physical therapy program.

RT equipment from Anand Agencies, Pune was utilized in the research. The device features a 4-digit, 1-ms chronoscope. Two response buttons, four stimuli, along with a ready signal are present. Using a switch, the right or left answer key can be selected. Two hours succeeding a light breakfast, laboratory recordings were made.

To prevent lateralized input, the patient was taught to make use of the right hand first, followed by his left. The current study tested both visual and auditory reaction speeds. The subjects were informed to release the reaction key as they viewed stimuli. Participants that received frontal inputs responded with their dominant hand in order to avoid lateralized stimuli. The participants were introduced to the RT measurement equipment on two separate days. After adequate training, RT becomes more reliable. The precision of RT measurements was 1 ms, and the statistical analysis utilised the mean of three pertinent observations acquired over 10 trials.

**Table 1: Sequence and Duration of Yoga Techniques Practiced by our Subject**

Yoga Technique	Duration (min)
Surya Namaskar	10
Tadason	0.5
Parivritta trikonasan	1
Padahastasan	0.5
Ardh-kati-chakrasan	1
Vakrasan	1
Pashchimottanasan	0.5
Pavanamukthasan	2
Ardha halasan	0.5
Bhujangasan	0.5
Dhanurasan	0.5
Viparitakarani	1
Chandranadi pranayama	2
Pranav pranayama	4
Nadi shuddhi	2
Savitri pranayama	3
Kayakriya	10
Shavasan	10
Rest period in between practices	10
<b>Total</b>	<b>60 min</b>

Blood extracted from the post-absorptive antecubital vein for biochemical tests. Physical therapy and yoga were forbidden on the day of the blood sample. Before and throughout the research period, blood samples for fasting blood glucose (FBG), two-hour postprandial blood glucose (PPBG), lipid profiles like triglyceride (TG), total cholesterol (TC), LDL, HDL, and VLDL was collected [4].

Using a retrospective, post-intervention wellbeing questionnaire created by The Advanced Centre for Yoga Therapy Education and Research (ACYTER) [5], the patient's contrasting feelings following the therapy program were assessed. To evaluate the patient's physical and mental state, five possible responses which ranges from "worse than before" to "complete relief/total satisfaction" were considered. A 12-person committee composed of three of the eminent medical experts, two psychologists, two yoga and physical therapy consultants, two educationalists, and one legal anthropologist finalized the questionnaire.

The patients got yogic counselling and advice for lifestyle adjustment during their initial visit to the ACYTER Yoga and Physical Therapy Outpatient Clinic. They then went to the ACYTER's special seminars for diabetes sufferers. At ACYTER, certified yoga and physical therapy instructors taught the patients a thorough yoga and physical therapy program for 60 minutes three times per week for six weeks. Table 1 includes the timetable.

Patients were instructed to practice with caution, taking their individual capacity into account. 99.63% of students attended the 18 sessions that were closely observed. Additionally, the patients were pushed to do at-home practise on various days. Five of the fifteen patients practiced at home four times per week, three times per week, and twice per week, respectively. While the other three patients reported practicing five, six, or seven days per week, only one patient reported practicing at home. An analysis of patient feedback found that home practice lasted thirty minutes for nine patients, sixty minutes for three patients, and forty minutes for two patients.

## RESULTS

**Table 2: Pre (B) and Post Values (A) of Fasting Blood Glucose (FBG), Postprandial Blood Glucose (PPBG), Total Cholesterol (TC), Triglycerides (TG), Low Density Lipoprotein (LDL), Very Low Density Lipoprotein (VLDL) and High Density Lipoprotein (HDL)**

	<b>B</b>	<b>A</b>	<b>% Change</b>	<b>P value</b>
FBG (mg/dl)	160.07 ± 15.65	127.07 ± 10.24	-20.62	0.0035
PPBG (mg/dl)	244.20 ± 17.12	208.73 ± 16.07	-14.52	0.0012
TC (mg/dl)	161.24 ± 9.10	152.95 ± 7.17	-5.14	0.0161
TG (mg/dl)	110.53 ± 10.56	99.6 ± 8.37	-9.89	0.0203
LDL (mg/dl)	96.53 ± 9.46	86.27 ± 7.78	-10.64	0.0012
VLDL (mg/dl)	22.11 ± 2.11	19.95 ± 1.67	-9.77	0.0222
HDL (mg/dl)	42.60 ± 5.16	47.07 ± 5.08	10.49	0.0229
TC/HDL	4.36 ± 0.46	3.60 ± 0.31	-17.37	0.0035
LDL/HDL	2.77 ± 0.40	2.15 ± 0.27	-22.41	0.0059
HDL/LDL	0.65 ± 0.21	0.77 ± 0.24	19.13	0.0165

Yoga and physical therapy exercises reduced the VRT and ART of both the left and right hands. However, only right-handed ART resulted in statistically remarkable decrease. The reduction in ART through the left hand was statistically significant (7.18%) but not statistically significant [Table 3]. The decline in VRT for the left and right and left hands was not statistically remarkable.

**Table 3: Pre (B) and Post Values (A) of Visual Reaction Time (VRT) and Auditory Reaction Time (ART) from Right and Left Hands**

	<b>B</b>	<b>A</b>	<b>% Change</b>	<b>P value</b>
VRT(ms)				
Right hand	250.82 ± 7.42	241.07 ± 5.92	-3.89	0.1096
Left hand	259.80 ± 7.72	251.44 ± 4.20	-3.22	0.1931
ART (ms)				
Right hand	196.87 ± 9.25	178.04 ± 6.36	-9.56	0.0357
Left hand	193.31 ± 6.19	179.44 ± 5.03	-7.18	0.0583

Significantly, FBG fell. In addition, the concentration of PPBG reduced by 14.52 percent (P=0.0012). The decrease in total cholesterol (TC) from (5.14%) was statistically remarkable (P = 0.016). In addition to the substantial (P=0.022) 10.64% decrease in LDL from and the remarkable (P=0.022) 9.77% reduction in VLDL, there was a promising (P=0.020) 9.89% reduction in TG. While the LDL/HDL ratio decreased by 22.41% (P=0.005), the TC/HDL ratio reduced by 17.37% (P=0.003). HDL/LDL ratio improved significantly (P=0.016) by 19.13%.

Table 4 offers a comprehensive breakdown of the response rates for each item. 27% of participants were significantly better than before, while 7% reported complete relief and satisfaction following the therapy program, as determined by the totality of all retrospective wellness assessments. 42% of people reported that their condition had improved, while 23% reported no change. One percent reported worse health than before.

**Table 4: Post-intervention % Responses of the Studies that have Reported that Yoga Training Results in Participants to Retrospective Wellness Questionnaire**

	Worse than before	Same as before	Better than before	Much better than before	Complete relief/ totally satisfied
Ability to concentrate	-	28.57	50	21.43	-
Control of anger/loss of temper	-	35.71	28.37	28.57	7.14
Appetite	-	33.33	25	25	16.67
Confidence level	-	28.57	42.86	21.43	7.14
Ease of breathing	-	26.67	40	26.67	6.67
Energy levels	-	33.33	33.33	33.33	-
Enjoyment of life	-	20	60	6.67	13.33
Feeling calm and fresh	-	33.33	33.33	26.67	6.67
Feeling of hopelessness	-	40	40	20	-
Feeling of loneliness	-	6.67	60	33.33	-
General flexibility	-	13.33	53.33	26.47	6.67
General mood	-	8.33	50	33.33	8.33
General sense of relaxation	-	14.28	50	28.57	7.14
General wellbeing	-	7.69	38.46	53	-
Joint mobility	-	13.33	40	33.33	13.33
Nervousness	-	28.57	57.14	14.29	-
Normality of menstrual cycles	-	25	25	-	50
Pain levels	-	13.33	53.33	26.67	6.67
Performance of day-to-day activities	-	21.43	42.86	35.71	-
Sleep quality/ duration	13.33	20	26.67	40	-
Stress levels	9.09	27.27	36.36	27.27	-
Total wellbeing score	1.07	22.8	42.19	26.76	7.13

Following yoga training, there was a statistically significant decrease in ART from the right hand. The average ART decreased from  $196.87 \pm 9.25$  milliseconds to  $178.04 \pm 6.36$  milliseconds (a reduction of 18.83 milliseconds). The reported p-value of 0.0357 indicates that this decrease was statistically significant. Yoga training also resulted in a decrease in ART from the left hand. The average ART decreased from  $193.31 \pm 6.19$  milliseconds to  $179.44 \pm 5.03$  milliseconds (a reduction of 13.87 milliseconds). However, the decrease did not reach statistical significance, as indicated by the reported p-value of 0.0583. The study found that the decrease in VRT from both the right and left hands after yoga training was not statistically significant. The specific values or percentages of change in VRT were not provided. The study demonstrated that yoga training led to a statistically significant decrease in ART from the right hand. While the decrease in ART from the left hand was appreciable, it did not reach statistical significance.

Following yoga training, there was a statistically significant decrease in FBG. The average FBG decreased by 20.62% from  $160.07 \pm 15.65$  mg/dl to  $127.07 \pm 10.24$  mg/dl. The reported p-value of 0.0035 indicates that this decrease was statistically significant. The average PPBG decreased by 14.52% from  $244.20 \pm 17.12$  mg/dl to  $208.73 \pm 16.07$  mg/dl. The reported p-value of 0.0012 indicates that this decrease was statistically significant. The average TC decreased from  $161.24 \pm 9.10$  mg/dl to  $152.95 \pm 7.17$  mg/dl, representing a reduction of 5.14%. The reported p-value of 0.016 indicates that this decrease was statistically significant. The average TG decreased by 9.89% from  $110.53 \pm 10.56$  mg/dl to  $99.60 \pm 8.37$  mg/dl. The reported p-value of 0.020 indicates that this decrease was statistically significant. There was a significant

decrease in LDL following yoga training. The average LDL decreased by 10.64% from  $96.53 \pm 9.46$  mg/dl to  $86.27 \pm 7.78$  mg/dl. The reported p-value of 0.0012 indicates that this decrease was statistically significant. The average VLDL decreased by 9.77% from  $22.11 \pm 2.11$  mg/dl to  $19.95 \pm 1.67$  mg/dl. The reported p-value of 0.022 indicates that this decrease was statistically significant. The average HDL increased by 10.49% from  $42.60 \pm 5.16$  mg/dl to  $47.07 \pm 5.08$  mg/dl. The reported p-value of 0.022 indicates that this increase was statistically significant. TC/HDL ratio decreased significantly by 17.37% from  $4.36 \pm 0.46$  to  $3.60 \pm 0.31$  ( $p=0.003$ ). LDL/HDL ratio decreased significantly by 22.41% from  $2.77 \pm 0.40$  to  $2.15 \pm 0.27$  ( $p=0.005$ ). HDL/LDL ratio increased significantly by 19.13% from  $0.65 \pm 0.21$  to  $0.77 \pm 0.24$  ( $p=0.016$ ).

These findings suggest that yoga training had positive effects on lipid profile parameters, including reducing total cholesterol, triglycerides, LDL, and VLDL, while increasing HDL levels. Additionally, improvements were observed in various lipid ratio measures.

7% of the participants reported attaining complete relief and total satisfaction after the therapy program. 27% of the participants reported being much better than before the therapy program. This suggests a substantial improvement in their well-being compared to their initial condition. The majority of participants, 42%, reported being better than before the therapy. This indicates a positive change in their overall wellness. 23% of the participants reported no change in their condition after the therapy program. This suggests that their overall wellness remained relatively stable. A small percentage, 1%, reported that their condition was worse than before the therapy program. This indicates that their overall wellness did not improve or may have worsened during the intervention.

## DISCUSSION

It was observed that diabetic patients had longer reaction times (RT) compared to normal subjects. However, it was demonstrated that a comprehensive six-week yoga therapy program led to a significant reduction in Aerobic Reaction Time (ART) in diabetic patients. This finding is notable, as it appears to be the first report of its kind. The shortening of RT in diabetic patients after the yoga therapy program can potentially be attributed to an increase in sensory-motor conduction velocity and/or faster information processing in the central nervous system. These physiological changes may underlie the observed improvement in reaction time. The significance of this finding extends beyond the physiological aspect, as faster reaction times are associated with better performance in various domains. This includes sports personnel who require quick reflexes, precision surgeons who need precise motor skills, and other professionals who rely on swift cognitive processing. Furthermore, it is interesting to note that a previous study conducted by the same researchers reported an immediate shortening of RT following the practice of nine rounds of mukha bhastrika, a bellows-type yoga breathing technique. This suggests that certain specific yogic practices may have an acute impact on reaction times, while the comprehensive yoga therapy program in the present study likely exerted a more sustained and long-term effect on improving RT in diabetic patients.

Fasting as well as post-prandial blood glucose levels decreased significantly in our subjects following the yoga therapy program. This is consistent with earlier studies that have reported that yoga training results in a reduction in both FBG and PPBG

levels and better glycemic control.[8,16] The 20.62% reduction in FBG in our subjects is comparable with the 6.1-34.4% reduction reported in a review of 25 studies on yoga and diabetes by Innes and Vincent.[4] has reported an improvement in insulin sensitivity and decline in insulin resistance in subjects practicing yoga while Manjunatha *et al.*, 2005 [18] reported that the performance of asanas leads to an increased sensitivity of the b cells of pancreas to glucose signals. It is possible that a similar mechanism is responsible for the improvements in blood sugar levels of our subjects. Increased sympathetic activity, enhanced cardiovascular reactivity and reduced parasympathetic tone have been strongly implicated in the pathogenesis of insulin resistance syndrome, atherosclerosis and cardiovascular diseases. Innes and Vincent[4] have suggested that yoga reduces this risk profile by decreasing activation of the sympatho-adrenal system and the hypothalamic-pituitary-adrenal axis and also by promoting a feeling of wellbeing along with direct enhancement of parasympathetic activity via vagus nerve. They also suggested that yoga provides a positive source of social support that is a factor associated with reduced risk for cardiovascular diseases. All these factors are applicable to our study and may explain the positive changes produced following the adherence to the comprehensive yoga therapy program.

It has been reported that a short lifestyle modification and stress management educational program leads to remarkable improvement in the subjective wellbeing scores and can therefore make an appreciable contribution to primary prevention as well as management of lifestyle diseases.[3] Majority of our patients reported an improvement in appetite, ability to concentrate, control anger, confidence levels, ease of breathing, energy level, enjoyment of life with calm and fresh feeling [Table 4]. They also reported a reduced feeling of hopelessness, nervousness and loneliness. They reported improvements in general flexibility and joint mobility along with better general mood, sense of relaxation and wellbeing. Menstrual cycles normalized in all four patients who were pre and peri-menopausal. There was a decrease in stress levels with improved quality and duration of sleep. This is similar to a recent report that yoga improves psychological outcomes in type 2 diabetes patients with improved well being and reduced anxiety.[17] Yoga may be improving mental and emotional components of the personality and subjective well being reported by our participants may be a contributing psycho-physiological factor in the desirable improvements shown by our patients. This aspect needs further exploration. Interestingly, one participant who didn't practice at home reported that there was an increase in her medication while the one who practiced every day at home, reported that her medication had reduced. Though both had reported improvements in the well being questionnaire, responses of the one who practiced every day were in the range of 'much better' to 'total relief' while responses of the other one were mainly in the 'same' to 'better' range.

The present study has several strengths that contribute to the validity and reliability of the findings:

Excellent compliance and regularity of yoga practice: The participants in the study demonstrated outstanding compliance and regularity in practicing yoga. During the directly supervised sessions, the attendance rate was reported to be 99.63%. Additionally, the participants practiced regularly at home, with only one patient reporting irregular practice. The average frequency of home practice was 4 days per week, with each session lasting 30-40 minutes. This high level of compliance and regularity enhances the internal validity of the study and strengthens the reliability of the observed benefits. The study utilized a comprehensive yoga therapy program,

which likely contributed to the all-round benefits observed in the participants. The program may have addressed multiple aspects of health and well-being, targeting various physiological and psychological factors associated with diabetes and cardiovascular risk. The comprehensive nature of the program suggests that the observed improvements can be attributed to the holistic approach of yoga practice. The study specifically included peri and post-menopausal female participants. This is important because menopause is associated with hormonal changes that can negatively impact cardiovascular health and increase the risk of cardiovascular disease. By focusing on this population, the study highlights the significance of the decrease in cardiovascular risk profile observed in the participants. This adds to the clinical relevance of the findings and suggests that yoga therapy may be particularly beneficial for women in this stage of life.

Absence of a control group and accidental sampling are study weaknesses. Since our participants also received hospital drugs, it is difficult to compare yoga, physical therapy, and medical care. Yoga and physical therapy offer additional benefits, given that the medical treatment approach that stabilized patients' clinical state was not altered. More randomized controlled trials are required to validate these outcomes and expand our understanding of their benefits.

## CONCLUSION

The findings of the study indicate that a comprehensive six-week yoga therapy training program can lead to significant improvements in various aspects of health among peri and post-menopausal diabetes patients. Specifically, the program demonstrated positive effects on reaction time, blood glucose levels, and lipid profile. The observed improvement in reaction time suggests enhanced sensory-motor conduction velocity and/or faster information processing in the central nervous system, which can have practical implications for individuals in various professional and performance-based settings.

Furthermore, the improvements in blood glucose levels and lipid profile, such as decreased fasting blood glucose and postprandial blood glucose, as well as reduced total cholesterol, triglycerides, LDL cholesterol, and VLDL cholesterol, indicate positive changes in metabolic health and cardiovascular risk factors. The comprehensive nature of the yoga therapy program, coupled with the excellent compliance and regularity of practice observed in the study, suggests that yoga can be an effective complementary or integrative therapy in the management of diabetes mellitus. By combining standard medical management with yoga therapy, individuals with diabetes may experience enhanced benefits and improvements in their overall health outcomes.

These findings support the potential of yoga as a holistic approach to health and highlight the importance of considering yoga as part of an integrative therapy program for individuals with diabetes, particularly those in the peri and post-menopausal stages. Further research and studies are warranted to validate these findings and explore the long-term effects and sustainability of yoga therapy in the management of diabetes and related health conditions.



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